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JUN 7

ELECTRICAL WORLD

June 25, 1932
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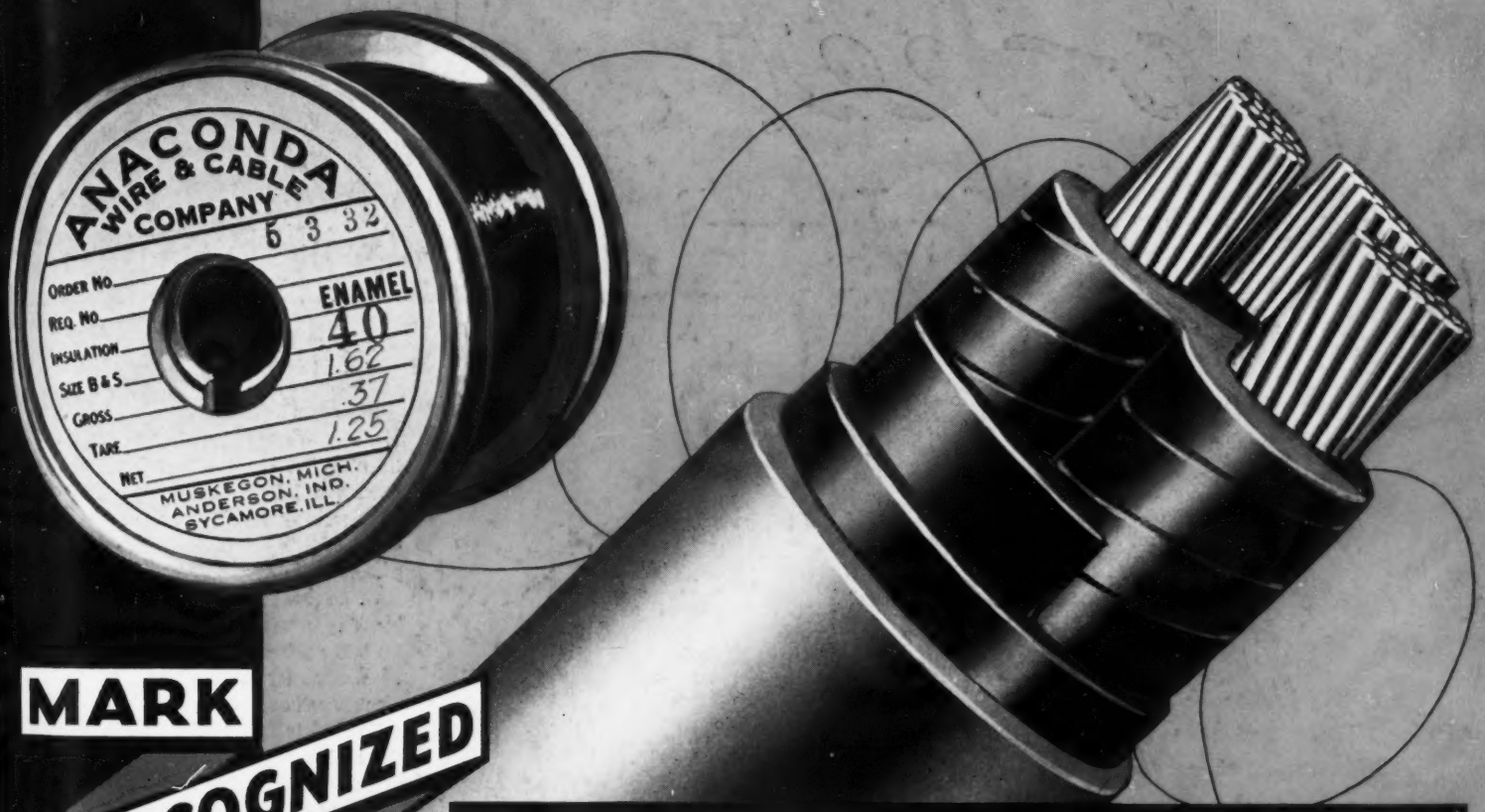

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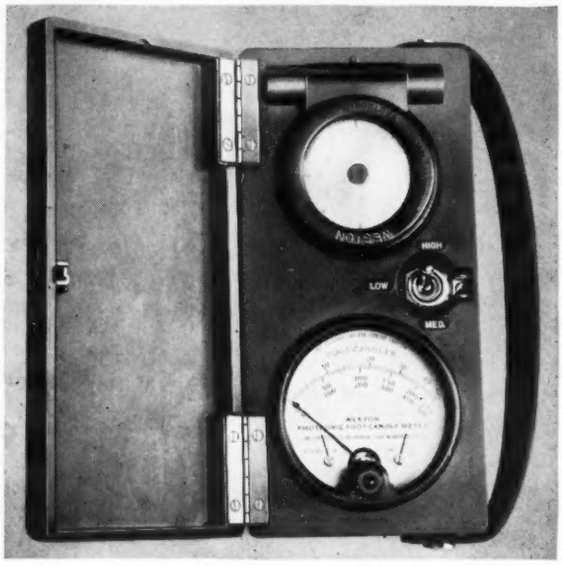

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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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JUNE 25, 1932

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VOLUME 99 . . . NUMBER 26

Reliability Vies with Economy for System Honors.....1084

Telemeter Uses Tubes and Standard Instrument Parts.....1089
By A. J. JOHNSTON, *General Electric Company*

Relays Operated from Bushing Potential Devices.....1092
By P. O. LANGGUTH and V. B. JONES, *Westinghouse Electric & Manufacturing Company*

History Repeats Itself.....1097
By JOHN E. ZIMMERMANN, *President United Gas Improvement Company*

Flashing Lamps Without Moving Parts.....1098
By C. G. SUITS, *General Electric Company*

News of the Industry.....1073
Editorials.....1082
Neat, Compact Substation Serves Low-Density Area...1088
Economics of 300-Mile Multiple-Conductor Line.....1091
Benchboard Facilitates Airport Dispatching.....1091
1.4 Kw.-Hr. per 100 Lb. to Cool Milk.....1096
500 Watts Keep Shrub in Bloom Through Winter.....1097
Pushing the Domestic Business.1099
Eye Specialists Turn to Lighting.....1099
Comfort Chart for Air Conditioning.....1100
Southern Industries Hold; West Falls Slightly.....1101
Electrical Manufacturing Leveling Up.....1101
Readers' Forum.....1102
Men of the Industry.....1103
New Equipment Available....1104

Electrical World articles are indexed in Industrial Arts and Engineering Indexes, available in public libraries

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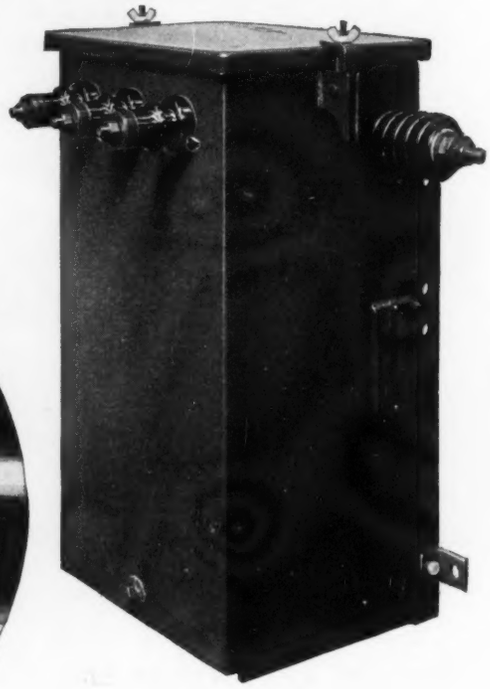

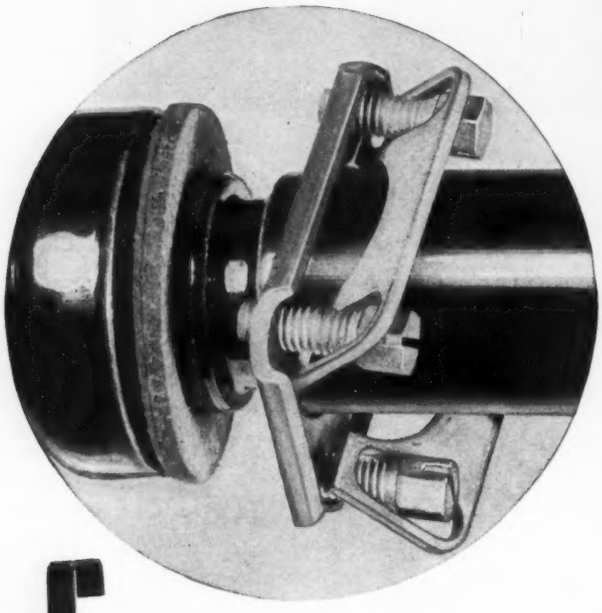

The bushing clamping assembly consists of two clamps, a retainer and four set-screws. The two clamps engage a groove in the bushing and are held inside the retainer when pressure is applied on the set-screws against the tank wall.

It is a very simple matter to loosen this clamping assembly and thus permit removal of the bushing: (1) loosen the screws — do not remove them completely; (2) part the clamps far enough to clear the bushing; (3) slip the entire assembly off the bushing; (4) slip the bushing thru the opening.

It's done in a jiffy—and all that's required is a screw-driver to loosen the screws . . plus a wrench to remove the transformer cable.

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

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ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

June 25, 1932

Electrical Engineers Prepare for Action as Depression Challenge

A.I.E.E. meets in Cleveland for summer convention.
Skinner declares engineering counsel could have avoided bankers' errors.
Design of systems and co-ordination of equipment topics.
Reliability with economy the goal of today's work.

WHETHER the engineer is the hero or the villain in today's economic tragedy is something the social audience has not decided. But of one thing it is sure, and that is that his economic philosophy is founded on the notion of abundance and plenty, while that of the business man and the banker is founded on the concept of scarcity. Such was the picture set up by W. C. Wickenden, president of Case School of Applied Science, in addressing the American Institute of Electrical Engineers at the annual summer convention in Cleveland this week. However, the conflict between these philosophies need not result in blame being cast upon the engineering profession for the growing prevalence of want and hunger.

It is not at all certain, in Mr. Wickenden's opinion, that technological unemployment will not prove to be more than a transient on the business oscillograms of the current period. If that proves to be the case the engineer will have to assert himself in civic affairs to insure that saving of labor be not a more calamitous thing to society than a more profligate use instead of the earth's resources to sustain the standard of living to which man has accustomed himself. Also, capitalistic democracy may already have arrived at a point where ploughing back into capital channels of the proceeds of thrift and technology will have to be superseded by a more immediate distribution of current earnings in the form of wages and dividends.

In his address to the Institute President Skinner ventured the suggestion that many of today's shrunken investments pertain to projects which engineers had condemned as unsound. There were other security flotations upon which engineering advice was neither sought nor desired. That it should be increasingly the practice of investors to insist that engineering and construction projects be reported upon and approved by independent engineers of the highest reputation for honesty and good judgment was the conclusion advanced by Mr. Skinner.

An interpretation of the status of engineering registration and its bearing upon the professional engineering societies took up the discussion at one of the sessions of the delegates. It seemed to be the opinion that sooner or later the qualifications for membership in the professional societies and in fact the requirements for degrees in the engineering schools of the country would be brought into agreement with the criteria set up by engineer licensing and registration boards in the various states.

This Week

Internal Revenue Bureau rules on energy tax. p. 1075
Associated Gas & Electric policies scored in New York. p. 1077
Reliability vies with economy for system honors. p. 1084
Relays operated from bushing potential devices. p. 1092
Comfort zones of air conditioning charted for reference. p. 1100
Accurate long-distance metering now possible. p. 1089
New York Edison rate savings exceed estimate. p. 1075

Reliability and economy sought

Factors which promote operating economy are not as much in conflict with those which promote system reliability as those which aim at economy of capital expenditure. Nevertheless, over-all economy of fixed and operating charges has been attained on several power systems in the face of declining loads; at the same time there has been a steady betterment of the operating reliability of the systems. Several factors have contributed to this, and not least among them has been a higher grade of operating technique.

Discussing the symposium on combined reliability and economy in operation of large electric systems, J. R. Baker of Baltimore reminded the members that the geographically extensive power system prognosticated a few years ago had materialized only in its physical interconnection aspects and not in the matter of bulk flow of power. Distances of transmission are great only when cheap water power or cheap fuel are available at points remote from the concentrated load areas. Tie-line loadings are primarily a matter of supplementation of energy generated within the load zone by incrementally cheap power from without.

The art of designing a perfect electric supply system is farther from being a closed book than it ever was, in the opinion of I. E. Moultrop of Boston. This was in some degree borne out by the diversity in attitude toward criteria of reliability and economy as expressed

by the authors of the four symposium papers (see page 1084 this issue). Current conditions, according to Mr. Moultrop, call for conservation of capital expenditures even if it be at some detriment to the day-by-day economy of operation.

Again, J. W. Anderson of Philadelphia pointed out that the joint consideration of reliability and economy in the system called for available capacity not less than the peak, with the largest unit on for overhaul and the second largest tripped out on emergency. As for Boston, A. H. Sweetnam reported that zone operation was so conducted that tie-line rating was about equal to the capacity of the longest unit at the ends of the link. He emphasized the bearing of incremental tie-line losses on the virtue of interchange energy transactions. The ampere-squared meter has proved very helpful in Boston in simmering down the energy interchange practices so that the less economical transfers may be progressively eliminated.

The technical sessions will be reported at length in next week's issue of ELECTRICAL WORLD.

Inspection of the Nela Park illumination research laboratories of the General Electric Company was paralleled on Thursday by the opportunity afforded for relaxation in a field day of sports at the park camp. The Goodyear Zeppelin plant at Akron and a high-tension demonstration at the outdoor laboratories of the Ohio Brass Company at Barberton provided attractions for the afternoon and evening of another day.

H. P. Charlesworth, vice-president of Bell Telephone Laboratories, Inc., New York, was elected president.

Other officers elected were: Vice-presidents—J. Allen Johnson, Buffalo; E. B. Meyer, Newark; K. A. Auty, Chicago; G. A. Mills, Dallas, Tex., and C. R. Higson, Salt Lake City. Directors—G. A. Kositzky, Cleveland; A. H. Lovell, Ann Arbor, Mich., and A. C. Stevens, Schenectady, N. Y. W. I. Slichter of New York was re-elected national treasurer.

▼

LIGHTING THE WAY TO THE OLYMPICS

Wide World Photos

Donated by the Pacific Coast Electric Association, this 21-ft. statue of a discus thrower stands high on a hill in Pasadena, Calif. Lighted, with changing-color floodlights which automatically vary in hue and intensity, it is one of light's contributions to the 1932 Olympics.

▼

Standards Association Asks Clean Coal Specifications

As the result of a recent letter ballot of the standards council, the American Standards Association has approved the initiation of a project to develop specifications for clean bituminous coal, with the American Institute of Mining and Metallurgical Engineers as sponsor. This project, originally proposed by the A.I.M.E. in May, 1931, has been the subject of an extensive canvass of producing and consuming groups during the past year. It is said that opinion has now crystallized into the view that, although the project is difficult, attempts should be made to harmonize the divergent interests affected by such a standard. Correspondence by the association with interested organizations indicates that the following covers, in a general way, the purpose of this project: Specifications outlining allowable limits of inacceptable material in prepared bituminous coal, whether mechanically cleaned or not, in sizes coarser than 2 in., the purpose being to define clean coal and not to standardize screen sizes.

Clean bituminous coal, it is pointed out by the association, is at present simply a name, with no guide or limit to determine what is meant when the term is used by coal mine operators or dealers. There are no generally accepted tolerances on the amount of non-combustible material that is permissible in a shipment of coal. A standard, it is said, will benefit both producer and consumer —the producer by furnishing a gage covering the purchase of equipment and the degree of preparation required to provide a satisfactory product, and the consumer through the assurance of receipt of uniform coal complying with accepted specifications.

▼

Second Rate-Cut Offer Made by Dallas P. & L.

Following the offer by the Dallas (Tex.) Power & Light Company to reduce its rates for electricity by 4 per cent to consumers whose bills exceed $2 monthly and its subsequent rejection by the city (ELECTRICAL WORLD, June 4, page 976) the company made a second proposition. This represents an estimated saving of $242,000 a year to consumers. The city asked a minimum concession of $360,000 a year. The new offer is based upon a discount plan ranging up to 4¾ per cent.

In making the second offer the company set forth at length its claims to rights under its franchise, and again declined to recede from the base rate of 6 cents per kilowatt for domestic consumption, except as that rate may be reduced by a system of discounts, to be temporary in application, covering existing economic conditions.

Negotiations are still under way, the City Council officially having neither accepted nor rejected the new offer.

▼

Utility Undertakes Sale of Used Appliances

Based upon the acceptance that rebuilt appliances, traded in or otherwise returned to the utility, offer definite service values, the British Columbia Electric Railway Company, Ltd., of Vancouver, B. C., has established a used-appliance market where such devices are offered at low prices.

Traded-in articles are thoroughly reconditioned, refinished if necessary and sold with a 90-day guarantee. The plan is reported to have proved popular, to have helped sales of new goods, and to have added to the company's domestic load.

That a good second-hand electrical appliance or radio is better than a cheaply constructed new article is said to be one of the sales arguments used.

Joint Conference Agrees on Home Wiring Essentials

An industry standard on residence wiring which will have the indorsement of various trade organizations may be looked for before the end of the summer. On Wednesday of last week the joint Industry Conference on Residence Wiring Standards, of which E. A. Brand is chairman, held its third meeting at the New York headquarters of the Society for Electrical Development and unanimously agreed upon the exact wording of a complete standard. A subcommittee was appointed to cast this standard into a form useful alike for architects and engineers. This, it is expected, will be completed soon enough to permit formulation before the end of the summer.

Several trade associations whose approval is necessary have yet to give their final consent, but according to Mr. Brand, excellent and encouraging progress is to be reported.

▼

Internal Revenue Bureau Rules on Energy Tax

Regulations, in preliminary form and subject to minor change, have been issued by the United States Bureau of Internal Revenue relating to the enforcement of the provisions of the revenue act of 1932 (ELECTRICAL WORLD, June 11, 1932, page 1002) regarding the tax on electrical energy. These regulations will be available at the office of every collector of internal revenue on or before June 30. It is specified that:

The tax is imposed upon all payments made on or after June 21, 1932, for electrical energy for domestic or commercial consumption furnished after June 21, 1932, and before July 1, 1934.

The tax applies to the amount paid for all electrical energy furnished for domestic or commercial consumption either by privately or publicly owned operating companies, but does not include industrial consumption defined as manufacturing, processing, mining, refining, public utilities, railroads, water works, etc.

The tax attaches to all payments whether made for energy, minimum charge, flat charge or otherwise. Where discounts or premiums are involved amount taxed is that actually paid.

Electrical energy furnished to the United States, any state or political division thereof is exempt from tax.

The tax must be paid by the person who pays for the energy furnished and must be collected by the person furnishing the service.

The tax is 3 per cent of the amount paid.

Utility companies must:

Collect the tax and make a monthly return to the collector of internal revenue.

Keep records of a full and adequate nature.

Make returns in duplicate, under oath, for each calendar month.

In the event of delayed payments interest at the rate of 1 per cent a month on the amount due is provided for.

Refusal to pay the tax by consumer or inability to collect it shall be reported to the collector of internal revenue by the utility.

Although not the subject of regulation, officials of the Bureau of Internal Revenue advise that returns may be made prorating the number of days remaining after June 21 covering energy furnished in that period. This applies only to the first bill.

▼

Fresno Mayor Fights for Reduced Rates

Possible condemnation and purchase of the San Joaquin properties in Fresno were threatened by Mayor Z. S. Lemel, who is dissatisfied with an assertedly inadequate reduction in city power rates granted by the California Railroad Commission. The Mayor has appeared before the Fresno City Council, with a proposal to float bonds to raise $2,500,000, a price at which he believes the system can be procured.

Officials of the San Joaquin and Midland companies have filed a petition with the California Railroad Commission (ELECTRICAL WORLD, June 18, page 1044) charging that the reductions granted were so great as to constitute confiscation. The petition, asking for a rehearing, said return of revenue under the rates fixed would be insufficient to pay 1932 operating expenses and dividends on preferred stock.

Immediately Claude L. Rowe, Fresno city attorney, began assembling data for a counter-petition which will declare that the rate base allowed is too high, that the reduction should have $1,000,000 instead of $650,000 and that charges against the consumer were allowed unjustly. Rowe also has been preparing to contest any attempt of the power company to obtain a court injunction before July 1, the effective date of the decision.

▼

Ontario Hydro Commission Investigation Concluded

After taking eighteen days' evidence, prolonged by adjournments over a period of almost five months, the Royal Commission appointed to investigate the Ontario Hydro-Electric Power Commission's affairs concluded its labors on June 17. A vigorous onslaught by Arthur G. Slaght, counsel retained by opposition parties in the Ontario Legislature, on the propriety of payments by the Hydro and the Beauharnois Power Corporation to John Aird, Jr., and a sharp debate between W. N. Tilley, commission counsel, and F. W. Griffiths, K.C., over the adequacy of the inquiry into the Hydro's acquisition of the Dominion Power & Transmission Company, marked the final sitting of the Royal Commission.

Some Business Factors Improve Slightly

PATCHES of blue "no bigger than a man's hand," which may or may not be of ultimate significance, appear on the otherwise clouded business-economic-politico horizon this week. Most recent figures for car loadings and lumber, energy and automobile production show appreciable and interesting increases. The bonus has been killed for the present at least. One national political convention with its follies, misrepresentations and expediencies has passed.

Most serious of the less favorable factors are: The practical failure though possible theoretical success of Congress to balance the budget, necessity for substantial unemployment relief, the certainty of several months of low levels of business activity, the continuance of bank failures, the weakness of all security markets, the virtual collapse of tax collections in some communities, and, above all, the uncertainties of the political situation.

There are many hazards to be avoided and many races to be run with all-but-spent horses before those patches of blue are likely to make glorious summer days.

▼

New York Companies Report Rate Savings

According to figures presented on Monday to the New York State Public Service Commission by R. B. Grove, vice-president of the New York Edison Company, retail consumers of electricity supplied by the four companies of the Edison System saved $6,495,722 from September 1, 1931, until May 1, 1932, under the new rates which became effective last July. Exhibits presented by Mr. Grove showed also that the new rates had resulted in smaller bills for 56.6 per cent of all customers of the system's companies, no change in the size of bills for 2.8 per cent, and increased bills for 40.6 per cent.

New York City, through Corporation Counsel A. J. W. Hilly, has fought the new schedules consistently both before and since their adoption. Mr. Hilly sought to show, in his cross-examination of Mr. Grove, that only the large consumers of electricity benefited from the new rates.

Coming Meetings

American Society of Mechanical Engineers—Bigwin Inn, Lake of Bays, Ontario, June 27-July 1. C. W. Rice, 29 W. 39th St., New York.

New England Division, N.E.L.A.—Mount Washington Hotel, Bretton Woods, N. H., July 11-13. Miss O. A. Bursiel, 20 Providence St., Boston.

Camp Co-operation XII — By boat to Bermuda, Aug. 3-8. Society for Electrical Development, 420 Lexington Ave., New York.

American Institute of Electrical Engineers—Pacific Coast convention, Vancouver, B. C., Aug. 29-Sept. 2. H. H. Henline, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 7-9. H. A. Buch, Telegraph Bldg., Harrisburg.

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 12-14. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Empire State Gas & Electric Association—Saranac Lake, N. Y., Sept. 22 and 23. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society—New Ocean House, Swampscott, Mass., Sept. 26-30. E. H. Hobbie, 29 W. 39th St., New York.

National Electrical Wholesalers Association—Hotel Statler, Buffalo, N. Y., Sept. 26-30. E. Donald Tolles, 165 Broadway, New York.

National Safety Council—Washington, D. C., Oct. 3-7. W. H. Cameron, 20 N. Wacker Drive, Chicago.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Oct. 6-8. T. C. Polk, 20 N. Wacker Drive, Chicago.

Association of Electragists, International—Kansas City, Mo., Oct. 10-12. L. W. Davis, 420 Lexington Ave., New York.

▼

South Carolina Court Defers Tax Ruling

After dismissing petitions of the Board River Power Company and the Lexington Water Power Company, both of Columbia, S. C., for an injunction restraining the South Carolina tax commission from collecting the tax on power, a three-judge federal court took the petition of the South Carolina Power Company of Charleston for the restraining order under advisement. The hearing was conducted at Asheville, N. C., by Circuit Judges John J. Parker of Charlotte and Elliott Northcott of Huntington, W. Va., and District Judge Ernest F. Cochran of Charleston.

The court declared, in explaining the reason for deferring the South Carolina Power Company decision, that it wanted to study the issue centering about the definition of current brought into South Carolina.

The companies are contesting the state's right to collect the tax of ½ mill on each kilowatt-hour of electricity generated or sold within the state. The tax was levied by the 1931 General Assembly after heated consideration. The arguments before the court centered largely on power generated in Georgia and brought into the Charleston area of South Carolina for distribution, the plaintiffs contending this was interstate commerce and that the state is without authority to tax the power.

Iron and Steel Engineers Active Despite Industry's Slump

EVEN though business barometers show the steel industry to be operating around 18 per cent of capacity, management has apparently recognized the value of exchanging experiences and practices, as 800 key men attended the 28th annual convention of the Association of Iron and Steel Electrical Engineers at Pittsburgh June 20-23. What it lacked in numbers was offset by the caliber of delegates and excellence of the program. Exhibitors, while fewer than in boom times, numbered 44, and the opinion was expressed by many that even if there is not much buying now, the engineering staffs are more interested than ever in equipment that will affect plant economies or assure continuity of operation. Furthermore, these staffs are in a particularly receptive frame of mind to analyze equipment which they will buy as soon as business begins to improve. Depreciation of unused equipment or that operated under abnormal conditions will require replacement buying eventually.

Substantiating this viewpoint were papers by steel men on such subjects as electrical developments in the iron and steel industry (the longest report ever presented), progress in the science of electric welding, standard control apparatus, three papers on electronic control devices, design and performance of fully compensated d.c. machines, water- and air-cooled boiler furnaces and new materials for roll-neck bearings.

Due to the occurrence of too many serious accidents, one entire afternoon was devoted to a discussion of what fundamental requirements must be written into regulations affecting work on high-tension lines to safeguard workmen's lives.

Operating problems included discussion of such subjects as fuel economy under curtailed operating conditions, reducing the bearing cost per ton of steel rolled, maintenance and care or recording instruments, influence of temperature and atmosphere on scale losses, determination of motor capacity for main roll drives, and ladle crane practice.

President J. J. Booth, National Tube Company, in opening the convention, declared that two major problems face steel executives: (1) Keeping the payroll intact by distributing available work, and (2) conserving cash surplus as far as possible. Between these problems are operating and producing problems that are greatly increasing operating and maintenance expenses and reducing the efficient use of fuels. The problems are so intricate that only by co-operative effort can they be solved. But he expressed implicit faith in the economic structure of the country and the judgment of its people. In due time prosperity and full-time employment will be here again, he declared.

W. H. Burr, Lukens Steel Company, who reviewed electrical developments, said: "In 1931 the steel industry underwent many changes and after this depression is over the benefits derived from the lessons learned will no doubt result in greater achievements than ever before. In the solution of its operating problems, whether they be heating, rolling, annealing, welding or transportation, the electrical industry is destined to play a leading part."

G. E. Doan, Lehigh University, outlined scientific investigation for improving the ductility of welds, studying the phenomena of arc welding, determining the kind of weld metal to use, methods of testing and what kinds of metals can be welded. Ductility has been increased to 20 per cent elongation or more. It is impossible to maintain an arc between pure iron electrodes in pure argon. A capsule of radium can be used to photograph imperfections in metal up to 10 in. thickness. Subsequent annealing was cited as the means of removing objectionable changes caused by welding, but is not necessary if the carbon content is low.

In the discussion of this paper H. W. Winne, General Electric Company, reported that mercury boiler tube developments have been made possible by use of an improved electrode giving a weld ductility of 40 per cent elongation.

A. F. Davis, Lincoln Electric Company, proposed the use of welding with a shielded-electrode electronic tornado for discerning slabs, a task now generally handled by burning out the seam. While the idea has not been applied in practice, factory tests prove its practicability, and the cost is said to be half that of present methods. Tests of such a weld indicate strength of 65,000 to 85,000 lb., a ductility of 20 to 30 per cent, an impact strength of 30 to 40 ft.-lb., a fatigue limit of 28,000 to 30,000 and the ability to twist 1,080 deg. without failure.

Although a proposed set of regulations for working on high-tension lines was submitted, it was decided after extensive discussion of the subject by steel mill and utility men to have a committee consider all the discussion presented and work up a revised set of regulations.

J. D. Donovan, Republic Steel Corporation, was elected president of the association. News of later sessions will appear in the next issue of the ELECTRICAL WORLD.

Associated Gas & Electric Policies Scored by New York Commission

CHARGING that the "letter as well as the spirit of the public service law has been violated," the New York State Public Service Commission vigorously denounced certain policies of the Associated Gas & Electric System in a report made last week.

Criticism centered around charges for managerial, engineering, accounting and other services against twelve operating companies of the system in New York State by affiliated non-utility service organizations.

The commission has threatened to order the twelve operating companies of the Associated System involved to make no further payments to, nor make any further charges in fixed capital or operating expense accounts for such fees, services and expenses of the service companies, unless those utilities charge such fees, services and expenses directly against certain accounts which will result in such charges and payments being borne directly and solely by stockholders of the operating utilities.

The service companies involved, with the payments during 1930 and 1931 to which the commission raised objection, are:

W. S. Barstow & Company	$1,198,585
Utility Management Corporation	2,016,606
Utilities Purchasing & Supply Corporation	207,434
Expenses of above three companies	421,414
Public Utilities Appliance Corporation	1,381,731
"System" expenses	1,214,080
H. C. Hopson & Company, Inc.	449,716
Daniel Starch and staff	123,322
Mid-State Fuel Corporation	696,013
Total	$7,708,906

The commission also criticises the operating companies and the Associated System for their failure to furnish certain detailed information, and has outlined its unsuccessful efforts to obtain the testimony and information.

In addition to the proposed restriction on service payments, the brief also contemplated an order to restrain the employees of the operating companies from devoting any part of their working time, for which they are compensated by the operating utilities, to the sale or exchange of any securities not actually issued by the operating utilities by which they are employed.

Associated makes reply

A statement issued by the Associated Gas & Electric Company following the release of the commission's report stated in part:

The publicity given out by the Public Service Commission was not unexpected. The recent agitation against holding companies and the vigorous attempts to make the public utilities a leading political issue, have led the commission to condemn contracts for management, construction and other services—always regarded by the industry and by previous Public Service Commissions, and recently recognized by the New York Legislature, as legal and proper—without any consideration whatsoever of the character or value of the services rendered or the reasonableness of the charges, and regardless of the fact that the payments were made in most cases under contracts over which the commission has no jurisdiction.

No complaint of diversion of operating funds can fairly be made without proof of unreasonable charges, and upon this subject no evidence was before the commission. The companies will be prepared to justify the payments at the proper time and place. It was the opinion of counsel that the proceeding instituted by the commission itself which involved no question of adequacy of service or rate regulation and was not based upon any complaint by any customer of any of the companies served, was not a proper or appropriate proceeding for such proof.

Company questions commission jurisdiction

With respect to the sale of securities of the holding company, no fair complaint can be made by the commission in view of the delays incident to the authorization of operating company securities by the commission, which have been the subject of frequent comment in connection with operating companies under other managements. The operating companies have received financial assistance from the holding company very largely in excess of the proceeds of holding company securities sold by their employees.

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Ripley Urges Publicity to Reduce Speculation

Testifying before the Senate banking and currency committee last week in connection with that body's stock market investigation, Prof. William Z. Ripley of Harvard urged full publicity in order to reduce speculative activities.

Professor Ripley would require corporations' presidents and boards to reveal how much stock they hold in their own concerns and would impose severe penalties for the use of fictitious names. He said:

"One of the best tests is whether the managers of a business stay with it, whether the captains of a ship stay with it or get in the lifeboat, steer the ship by radio and tell everybody by radio to get on the ship.

"One of my cardinal rules is never to buy anything that any one wants to sell terribly."

The witness criticised many auditing firms for misleading statements respecting affairs of corporations. He said they were prone to take just a balance sheet and on that basis announce in a certification that the company is sound. He complained further that the auditors in too many instances were either un-

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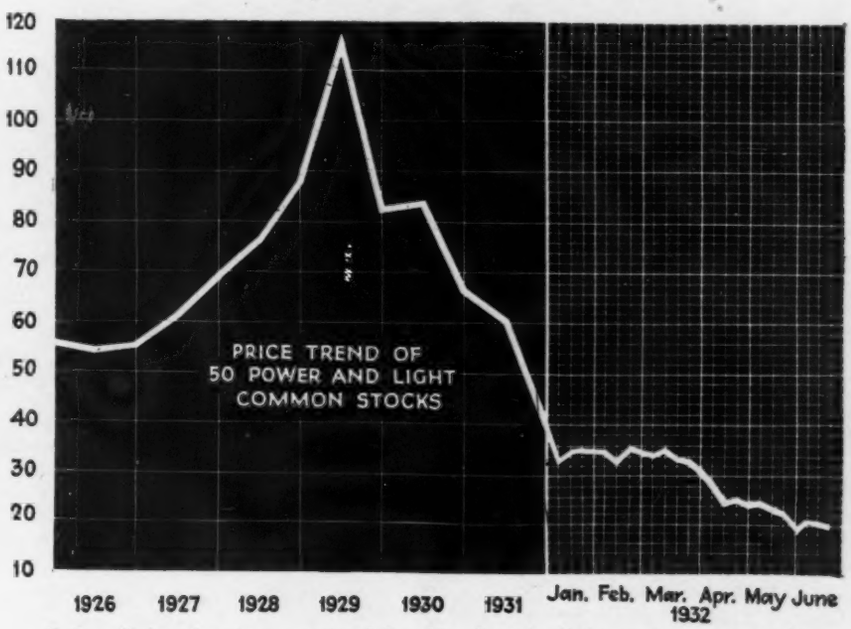
Utility Stocks Inactive



Only slight changes occurred in the electric light and power stock list during the past week, prices moving within a narrow range. The "Electrical World" index was 19.8, as compared with 20.0 in the preceding week.

willing or unable to get facts which they should analyze before making a certification on a corporation statement.

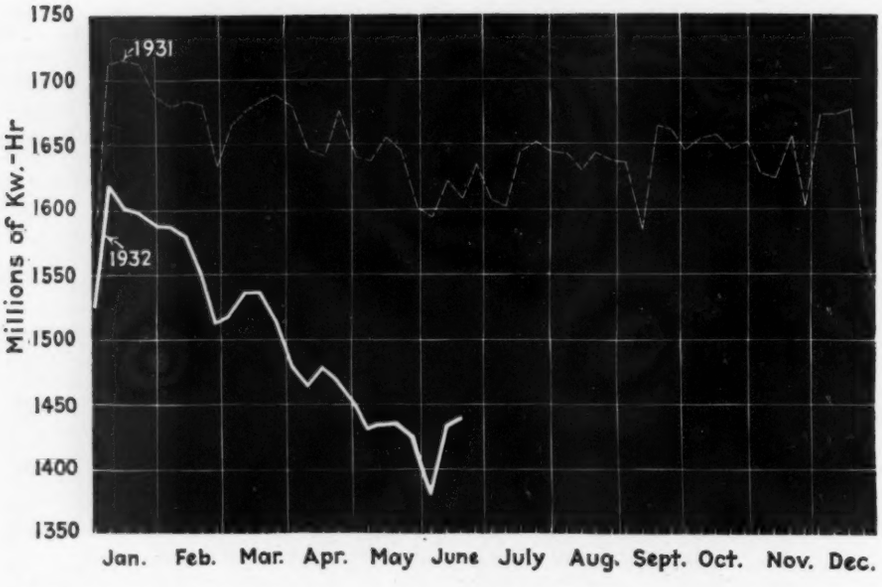
"Of course," he continued, "there are so many instances where the most skilled analyst cannot tell when a corporation is sound. It is simply impossible. But it would not be impossible if a standardized government form had to be filled out and filed with a federal agency and a heavy penalty attached for breach of the requirement."

Hydro Developments Go Ahead Steadily in India

Formal inauguration recently marked the completion of the Bahadrabad power station, the first stage of an important project for deriving hydro-electric power from falls on the Upper Ganges Canal, one of the oldest and largest irrigation systems of northern India. The scheme is an attempt to provide cheap power to 66 towns and villages with a population of 5,000 or over and to intervening farm lands. On the canal there are thirteen falls ranging from 6 ft. to 12 ft., and ten of them, capable of yielding 50,000 hp. minimum, have been selected for electrification. The present project provides 13,000 hp. of this total, with 2,500 hp. of oil-engine reserve power, from four of the falls. The largest of these stations, that at Bahadrabad, has four turbines driving four 1,000-hp. generators.

Completion of the tunneling of the Dhauladhar range of the Himalayas, 200 miles from Lahore, in connection with the Punjab government's scheme for the supply of hydro-electric light and power to the towns and villages of the province, is announced. The tunnel is 9 ft. in diameter and nearly 3 miles long. It is expected that the first part of the project, with generating capacity of 36,000 kw. and distribution lines for seventeen large towns, will be ready next January. The second part will double the supply, and the third part will involve 48,000 kw., making a total of 120,000 kw.

Output Again Increases



ANOTHER moderate rise in the energy output of central stations for electric light and power is reported by the National Electric Light Association for the week ended June 18. The total is given as 1,441,532,000 kw.-hr., a decrease of 10.5 per cent compared with the corresponding week last year. The decrease is the smallest since the week of April 16.

The rise brings the output for a June week with long daylight hours above that for any week in the preceding May, which is unusual. It has been suggested that a spurt on the part of some manufacturers to get products on the market before the new taxes go into effect may have affected energy consumption.

In each geographical region listed the deficiency from 1931 was smaller than during the week before. The greatest gain was in New England.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1932	1931	1930	1929
June 18.....	1,442	1,610	1,698	1,703
June 11.....	1,435	1,621	1,707	1,699
June 4.....	1,381	1,594	1,657	1,690
May 28.....	1,425	1,602	1,660	1,615
May 21.....	1,436	1,645	1,723	1,705

Per Cent Change from 1931

Region	—Week Ended— June 18	June 11	2 Wks. June 4
Atlantic Seaboard.....	— 6.3	— 9.0	— 9.0
New England alone..	— 9.5	—13.5	—11.7
Central industrial.....	—12.7	—14.3	—15.2
Pacific Coast.....	— 7.6	— 8.9	— 7.4
United States.....	—10.5	—11.5	—12.2

Italy's Electrical Output Is Increasing

Electric power production in Italy, including imports, continues to grow, according to a consular report. The output amounted to 776,992,000 kw.-hr. during February, 1932. This was 7.54 per cent more than the quantity generated in the same month of 1931. The quantity produced during the two months January and February reached 1,585,425,000 kw.-hr., an increase of 5.02 per cent over the corresponding period of the year before.

At the end of February, 1931, total installed generator capacity in the plants reporting to U.N.F.I.E.L. (National Fascist Union of the Electrical Industry), estimated to cover 94 per cent of the industry, amounted to 4,246,000 kw., while on the same date of 1932 the corresponding figure was 4,458,000 kw., an increase of 4.99 per cent in spite of the fact that a considerable surplus of power production has existed for some time. Concession for the development of hydro-electric power outstanding on February 29, 1932, totaled 6,261,912 hp., of which 3,337,411 hp. is already developed and active in generating stations. During January and February plants having a total of 6,222 hp. were completed and placed in service, but no new construction of importance was begun.

200 Kw. Lights Golf Course

At the Ingleside public golf course, San Francisco, 129 projectors, each with 1,500-watt sources, are grouped on 23 light centers at a height of 70 ft. According to W. R. Marshall, commercial vice-president of the Westinghouse Electric & Manufacturing Company, "this is the first effort in world history to light a standard size course for night use. In its success will lie a new field in illumination possibilities." About 55 acres of fairway and rough are covered by the plan, which includes special diffusing lenses to eliminate glare and spread the light.

Suspension Insulators Developed by Corning

After many years of experimentation and development work suspension-type insulators of "Pyrex" are to be offered by the Corning Glass Works for transmission-line service. The units, according to W. H. Taubert, sales manager, insulator division, are planned for regular production at an early date and will probably be available for use early in the coming year.

These insulators will be of the conventional 10-in. disk type and will be made in both the clevis and ball-and-

socket design. They will be furnished with drop-forged or malleable hardware. A feature will be the elimination of cement and the hardware will be assembled to the body with alloy.

It is stated that field tests have indicated the ability of this insulator to withstand power arcs to a remarkable degree. This is said to be the first time that suspension-type units have ever been successfully produced using this or similar material.

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New York Metal Prices

	June 15, 1932 Cents per Pound	June 23, 1932 Cents per Pound
Copper, electrolytic	5.33	5.33
Lead, Am. S. & R. price	3.00	3.00
Antimony	5.00	5.00
Nickel, ingot	35.00	35.00
Zinc, spots	3.15	3.12½
Tin, Straits	19.30	19.70
Aluminum, 99 per cent.	23.30	23.30

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Refrigerator Manufacturer Shows 17-Month Sales Gain

Convincing evidence that there can be and are exceptions to the general levels of activity come along from time to time. For the seventeenth consecutive month manufacturers of Norge refrigerators are able to report a sales increase. According to Howard E. Blood, president of the Norge Corporation, sales for the month of May were 111 per cent of those for the corresponding month in 1931. Sales for the first quarter of 1932 were 241 per cent of those in the same period of 1931.

"In 1931," states Mr. Blood, "Norge sales were 460 per cent as compared with 1930, and our present rate of progress indicates a very high percentage of gain this year over 1931."

Kelvinator also reports encouraging results for the current period. According to H. W. Burritt, vice-president in charge of sales of the Kelvinator Corporation, unit shipments for the month of May were approximately 17 per cent greater than for the corresponding period in 1931. The relationship between May and April of this year was more favorable than in 1931; this was significant when it is known that April shipments this year were the largest in the corporation's history.

In commenting on the general situation Mr. Burritt added: "Sales improvement during recent months is due largely to increases in dealer and distributor outlets and to more intensified sales effort. This is particularly gratifying in view of the fact that public utility sales programs this year are unusually late."

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Arrangements Completed for Camp Co-Operation XII

Final arrangements have been made with the steamship company for the accommodation of conferees at Camp Co-operation XII aboard the steamer *Pan-America*, sailing August 3 for Bermuda. The steamer will leave New York at 2 p.m., returning to New York at 9 a.m. Monday, August 8.

The business program committee, under the chairmanship of J. E. North, is making good headway in developing the details of a most constructive program, details of which were given in the May 21 issue of the ELECTRICAL WORLD, page 875.

Major New Construction This Week

HEAVY-DUTY motors, controls, conveyors, other material-handling equipment and power substation apparatus will be installed in each of three incinerator plants for Department of Sanitation, New York. Total appropriation authorized, $2,886,000.

Machine drives, motors, controls will be required for expansion program at plant of Palmer Match Company, Akron, Ohio. Cost over $100,000.

Until June 30, bids are being asked by General Purchasing Officer, Panama Canal, Washington, D. C., for transformers, watt-hour meters, wire, cable clips, light reflectors and other electrical and mechanical equipment (Schedule 2762).

Machine drives, heavy-duty motors, controls, conveyors, etc., will be installed in paper and pulp plant addition for E. B. Eddy Company, Ltd., Hull, Que. Estimated cost over $300,000.

Power substation equipment, motors, controls, panelboards, electric recording and time systems, lighting equipment, etc., will be installed in new buildings of Tennessee Agricultural and Industrial College, Nashville, Tenn. Fund of $800,000 being arranged.

Machine drives, motors and controls, conveying and other electrical equipment will be installed in addition to Lane Cotton Mills Company, New Orleans, La. Cost over $80,000.

Motors, pumping machinery, controls and auxiliary electrical equipment needed for new waterworks pumping and distributing plant of Department of Public Works, Milwaukee, Wis. Estimated cost over $200,000.

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Exports of Electrical Equipment (Preliminary)

Article	April 1931	April 1932
Generators:		
Direct current	$33,408	$6,398
Alternating	5,034	329,985
Steam turbo-generator sets	748,699	2,320
Accessories and parts	63,232	15,232
Arc-welding sets	29,738	21,481
Self-contained lighting outfits	34,438	12,617
Batteries	497,396	333,774
Transforming or converting apparatus:		
Power transformers over 500 kva	53,372	14,750
Distribution transformers, 500 kva. and less	75,322	18,024
Instrument transformers	8,382	6,525
Other transformers	34,389	35,863
Complete battery chargers, non-rotating	5,778	1,457
Double-current and motor generators, dynamotors, synchronous and other converters	119,383	28,080
Transmission and distribution:		
Switchboards, circuit breakers over 10 amp. and fuses	180,864	73,326
Watt-hour and other measuring meters	93,651	16,742
Indicating and recording instruments	79,324	63,493
Other electrical testing apparatus	40,249	101,963
Lightning arresters, choke coils, reactors and parts	58,993	40,356
Motors, starters, etc.:		
Fractional-horsepower motors	$260,093	$102,467
Stationary motors	199,423	56,111
Railway motors	800	.....
Electric locomotives	95,775	12,074
Electric motor trucks	9,643	.....
Starting and controlling equipment	150,802	40,482
Portable electric tools	85,064	28,296
Accessories and parts	139,095	71,704
Electric refrigerators:		
Household	1,165,547	317,711
Commercial up to 1 ton	283,622	178,022
Parts	371,398	253,461
Electric appliances:		
Flashlight cases	49,421	34,233
Electric fans	54,460	30,503
Electromechanical health exercisers	2,772	484
Electric incandescent bulbs	80,454	51,214
Searchlights and floodlights	68,526	1,705
Electric household washing machines	116,034	19,228
Electric domestic vacuum cleaners	138,052	41,129
Other domestic motor driven devices except tools	49,836	13,867
Electric flatirons	25,731	3,441
Electric cooking ranges	34,913	10,871
Other domestic heating and cooking devices	66,536	22,787
Industrial electric furnaces, ovens and other heating devices	77,221	8,512
Therapeutic and X-ray apparatus	$108,750	$47,722
Signal and communication devices:		
Radio apparatus	1,713,830	1,143,585
Telegraph apparatus	25,729	18,239
Telephone apparatus	243,190	77,188
Bells, buzzers, annunciators and alarms	24,428	13,083
Other electric apparatus:		
Starting, lighting and ignition equipment	82,447	61,084
Insulating material	65,294	15,447
Miscellaneous wiring supplies	883,901	488,679
Electrical porcelain	188,043	50,631
Carbons and electrodes:		
Electrodes for electric furnaces	141,105	128,279
Other carbon products	44,117	.....
Carbon brushes and stock	.....	9,065
Other carbon products	.....	31,785
Insulated iron or steel wire and cable	4,941	12,348
Copper, bare, wire	118,460	26,512
Insulated copper wire and cable:		
Rubber-covered wire	32,303	52,120
Weatherproof wire	27,436	18,158
Telephone cable	9,537	7,973
Other insulated copper wire	208,608	34,591
Nickel-chrome electric resistance wire	12,077	14,230
Electric clocks	.....	4,839
Totals	$9,621,066	$4,676,246
Four months ended May 31	32,718,946	18,485,275

Delegates to International Congress

The following have been designated as delegates from the United States to the fifth International Congress of Electricity meeting in Paris July 4-12: Arthur E. Kennelly, chairman, professor emeritus of electrical engineering Harvard University; Walter G. Cady, Foss professor of physics Wesleyan University; Roswell C. Gibbs, professor of physics Cornell University; Harold Pender, professor of electrical engineering and dean Moore School of Electrical Engineering, University of Pennsylvania, and Elihu Thomson, director Thomson research laboratory, General Electric Company, Lynn, Mass.

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New Unit at Kearny Station

Capacity of the Kearny generating station of the Public Service Electric & Gas Company (N. J.) was raised to 289,500 kw. last week by the placing in preliminary operation on Wednesday of a new 75,000-kw. turbo-generator unit. This is said to be the largest electric power generating unit in New Jersey. Its capacity is twice as great as that of all the machines in the fourteer generating stations of the system when the corporation was organized in 1903. An auxiliary feature is the welded steel condenser, reputed to be the largest of its kind ever built.

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Hoover Dam Appropriation Cut

Though $15,000,000 was appropriated for Hoover Dam in the fiscal year ended June 30, 1932, the United States Bureau of Reclamation reports the appropriation for the coming year to be but $6,000,000. Present expenditures on the Boulder Canyon project now amount to $2,000,000 a month. Total appropriations to date, $31,666,000.

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Eastern Utilities Exchange Plan

An offer is being made to holders of Eastern Utilities Investing Corporation 5 per cent debentures, due 1954, to accept Associated Gas & Electric Company debenture bonds, consolidated refunding 4½ per cent series, due 1958, in exchange on a par-for-par basis. Only one-third of the original $35,000,000 Eastern Utilities issue is outstanding.

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Northwestern Power to Default

According to an announcement by Edward Anderson, president, the Northwestern Power Company of Manitoba will be unable to meet the semi-annual interest payment on its $10,000,000 first mortgage sinking fund convertible gold bonds, due July 2. In making the announcement of deferring the interest, President Anderson said: "The company's plant at Seven Sisters has recently been completed, but owing to unfavorable economic conditions we have not been able to develop a load for the plant. We expect that with the return of better times the company will be able to find and develop a market for its power."

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This month, and this summer, will clearly constitute a difficult period, with complications arising abroad, and with business activity at a low ebb in this country. Nevertheless real progress is being made in banking, in credit, in the bond market, and in national finance. These accomplishments are not spectacular, and they do not furnish work for the unemployed. They do, however, constitute the essential basis from which increased business activity can start.

LEONARD P. AYRES,
Vice-President
Cleveland Trust Company.

[Colonel Ayers, long known for his comments as an economist, sometimes wrong, but more often right in the light of subsequent happenings, pointed out last week some specific favorable developments in the present situation.]

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Empire Power Reduces Capital

Stockholders of the Empire Power Corporation have been advised that the capital of the company has been reduced from $23,733,000 to $11,283,000 by their unanimous consent in order to comply with the statutory provision in New York State prohibiting the declaration or payment of dividends unless the value of assets remaining after the dividends shall be at least equal to the company's capital and other liabilities.

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Cities Service Drop in Net

For the month of May Cities Service Company reported a net income of $1,346,851 available for common stock and reserves, against $1,504,275 for the similar month a year ago, this decrease resulting in a reduction in salaries ranging from 10 to 20 per cent, effective immediately.

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Consolidated Gas to Finance

The Public Service Commission has authorized the Consolidated Gas Company of New York to issue $30,000,000 of 25-year 5 per cent gold debenture bonds, to be sold within 60 days at not less than 94 per cent of par and accrued interest. Proceeds of not less than $28,200,000 are to be applied to the discharge of the company's obligations. Although the commission authorized the issuance of the securities within 60 days, public offering will probably not be made until the bond market conditions are improved.

Insull Auction Deferred

The auction of various stocks held by four New York banks as collateral against loans made to Insull Utility Investments, Inc., and the Corporation Securities Company of Chicago, scheduled for June 21, has been adjourned to noon, July 20. An order allowing the receivers of the Middle West Utilities Company to discontinue twelve life insurance policies of Samuel Insull and associates and to collect the cash surrender value on them was granted June 21 by Federal Judge Lindley of Chicago. The policies total $2,436,000, with the Middle West as the beneficiary.

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Jersey Utility Cuts Dividend

Directors of the Public Service Corporation of New Jersey voted June 21 to make a 6 per cent reduction applicable to both its payroll and to dividends payable to holders of its common stock. The 6 per cent cut in salaries will amount to about $1,050,000 for the remainder of this year and the 6 per cent cut in the common-stock dividend will aggregate $550,000. The dividend rate on the common stock will be reduced from $3.40 annually to $3.20 a share, or an aggregate reduction of $1,100,639 a year on the 5,503,193 common shares outstanding.

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Canadian Association Elects

At the final session of the Canadian Electric Association meeting at the Manoir Richelieu, Murray Bay, Que., June 14 to June 17, the following officers were elected: President, J. S. Parker, Ottawa; vice-presidents, A. D. Robb, Niagara Falls, John Morse and R. B. Baxter, Montreal; treasurer, C. W. Henning, Montreal, and secretary, B. C. Fairchild, Montreal.

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American Superpower Securities

Stockholders of the American Superpower Corporation have been informed for the first time of the complete list of the securities held in the company's treasury. The major holdings are:

United Corporation $3 preference stock, shares	285,700
Commonwealth & Southern Corporation common, shares	5,000,000
Warrants	2,721,447
United Corporation common, shares	1,000,000
Warrants	993,400
Consolidated Gas Company of New York, shares	75,000
Niagara Hudson Power, new, common, shares	54,634
A warrants	300,000
C warrants	300,000
Electric Bond & Share common, new, shares	59,790

This list of securities as of June 9, 1932, had a market value of $27,212,813.

Four Recipients of John Scott Awards Named

John Scott awards have been presented to William Le Roy Emmet, consulting engineer of the General Electric Company, Schenectady, for development of the mercury boiler; Dr. Joseph Slepian, consulting engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, for his discoveries in the field of deionization of gases and fundamental inventions involving these discoveries; George H. Emerson, inventor, of Baltimore, for his water-tube firebox boilers, and Edward G. Budd, automotive manufacturer of Philadelphia, for his process of shot-welding stainless steel.

These awards, consisting of a bronze medal, a certificate and $1,000, are made by the city of Philadelphia board of directors of City's Trust for inventions or developments of industry which may add to the comfort, welfare and happiness of mankind.

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Mercury-Vapor Rectifier Under Trial in Boston

An experimental installation, the first of its kind, is being made by the Edison Electric Illuminating Company of Boston, in the form of a General Electric polyphase phonotron rectifier at the Salem Street substation of the company in Boston. The equipment converts alternating current to direct current by means of hot-cathode mercury-vapor tubes. The outfit has a capacity of 150 kw. and consists of six tubes with the necessary power transformer and switching apparatus, and control equipment.

Intended for use on the fringe of the direct-current Edison three-wire system, the equipment is being installed in a substation near the fringe in order that operating experience and data can be obtained from an attendant who can watch its behavior under changing load conditions. At Salem Street 13.8-kv. incoming alternating-current energy is at present transformed to direct current through a motor-generator and rotary.

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Suction Dredges Use Turbo-Electric Power

Cutters of 225 hp. and suction equipment totaling 1,200 hp. more will be used on each of the two new pipe line dredges being built for river and harbor maintenance and development in the St. Louis district on the Missouri and Mississippi Rivers for the U. S. War Department. A 20-in. pipe line will discharge sludge as much as 1,000 ft. from the shore. The new dredges will be among the most efficient ever designed, say Westinghouse engineers. Steam turbines will drive electric generators, which, in turn, will furnish energy for the motor drives.

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New Type Storage Battery Exhibited in France

Consisting essentially of a center electrode of carbon surrounded by an absorbent material saturated with zinc iodide and contained in an electrode sheet of metallic zinc, a new type of electric storage battery was announced before the French Academy of Sciences last week. F. Boissier is the inventor.

It is said that when the battery is charged the zinc iodide breaks down into metallic zinc that is deposited on the zinc sheeting and iodine that accumulates on the carbon electrode and in the absorbent material which may be an absorbent carbon powder. The zinc iodide is re-formed during the discharge.

M. Boissier claims the iodine storage battery to be superior to conventional storage batteries of the lead or nickel-iron varieties, the plates do not disintegrate, there is no acid or caustic liquid to spill, no dangerous gases or vapors are given off, and continual maintenance is not necessary. The iodine battery is rugged and easily transported. A disadvantage is reported to be its high internal resistance, but high output is obtained by making the batteries long and of small diameter and operating them in parallel.

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20,000-Kw. Boilers Supply Process Steam

Electricity not only provides the power for mechanical processing but also all the steam requirements at the recently completed cellophane plant of Canadian Industries, Ltd., Shawinigan Falls, Que. A 20,000-kw. substation has been erected alongside the plant. This station supplies the power for the machinery and includes two 10,000-kw. electric steam boilers, which eliminate the building of a coal-fired plant with the necessary coal-handling and storage facilities. As continuity of power is vital to the manufacture of cellophane, a dual source of supply is provided by tapping the trunk lines from three separate hydro-electric developments in the vicinity.

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STEEL BANK CHECKS FOR WELDING-PRIZE WINNERS

Lincoln Electric Company

First, second and third winners in the Lincoln arc-welding prize competition this year received their awards in the form of checks written with arc welding on ⅛-in. steel plates 24 in. long and 10 in. wide. J. C. Lincoln, treasurer of the company, is signing one of the checks. They will be indorsed by the same method and canceled with a machine gun.

EDITORIALS

L.W.W.MORROW
Editor

Why not make water-heater specifications more uniform?

WATER-HEATER specifications show what a chaotic condition exists in this branch of the industry. The number of possibilities of combinations of heater sizes and wattages and controls is almost infinite, almost as great in variety as the combinations obtainable out of a deck of ordinary playing cards. There are large tanks with small heaters, small tanks with large heaters, controls of time and temperature and off-peak almost without limit in variety of design. Some want one element, some two, some three. Some want temperature control on one, two or all; some want temperature control on none, just off-peak time control. Some want two tanks, some one tank with a division in it. The normal procedure has been for each utility in turn to delegate an engineer to make a survey of the water-heater situation. The survey has taken from one year to three years to make. The engineer has had free rein to make his tests and arrive at his conclusions. His report is based on these tests and his recommendations are final. Didn't he make a careful investigation? Could he be wrong? Of course not. It took him and his assistants two years to arrive at this conclusion. They had the able assistance of Mr. So-and-So of the Blank Company, which has had wide experience in water heating. The report must be right.

Surely there cannot be such a discrepancy in generating and distributing methods in the United States as absolutely to necessitate more than three hundred separate and distinct types or combinations of water heaters, including controlling mechanisms and methods of application. Surely some standards of tank size or control can be arrived at which will enable manufacturers to make a heater that will answer at least 60 or 70 per cent of the needs.

Self-regulating distribution transformers?

WHEREVER and however voltage regulation is introduced into the system, its primary function is to give the customer practical constancy of voltage. Occasionally some one asks why, if that is the case, the regulating mechanism should not be installed at or close to the customer's service entrance? Why not so build distribution transformers that they will be self-regulatory?

Regulation has gradually moved outward from the station. Compounding and Tirrills at the generator supplanted hand regulation at the old direct-current stations. Induction regulators at substations, and more recently out on the lines, came in after alternating current showed its inherent inferiority to the direct-current system in the matter of voltage regulation. In the last few years the rise of the alternating-current network has reintroduced an inherent tendency toward voltage stability on the circuits right up close to the service entrance. To equal this characteristic of the network the radial system will continue to require regulation with compensation to the load center.

The transformers out on the radial primaries can be made self-regulatory just like interconnection transformers—at a price. The price is, however, likely to be prohibitive by comparison with that of induction feeder regulation. Consequently the induction regulator is foredestined to remain a component of alternating-current distribution.

Overlooking opportunity

IN THE convention hotel the ballroom has been filled with undertakers' chairs, and on them sit in varying degrees of discomfort an assemblage including electric utility executives, department heads, manufacturers' representatives, engineers, salesmen and, of course, the ubiquitous ELECTRICAL WORLD editor. One speaker denounces government in business, another portrays mounting taxes, a third proves that the depression is only psychological, while the audience sinks deeper and deeper into a coma that is only slightly disturbed by the beating of words about its collective head.

Next comes a speaker who is on the program to discuss the great commercial future of the electric utility industry. He draws a word picture of a land where cooking is entirely electrical, where electric refrigerators abound and water heaters inhabit every basement. He waxes positively lyrical about the latest application of the kilowatt-hour in air conditioning. But his audience, if not asleep, is comatose or unconscious from breathing the same air over and over again as the hours roll by.

The editor sits and wonders in a befuddled sort of way—the perception even of an editor relaxes after he has become so well acquainted with the air in a room as almost to be able to tell how often each single molecule has visited his lungs—wonders why with all this talk of air conditioning no one has ever thought to see whether it would work in convention meeting rooms.

Wanted—"fight" in industry

IT IS useless to look to Congress for further sugar-coated remedies to relieve the deflationary movement upon which this country has embarked. It has passed the major legislation asked of it, and the credit-inflation, budget-balancing programs have proved quite ineffective to stop the downward trend. Now the presidential campaign is starting and all politicians are playing a static and conservative game in order to retain or obtain office. National leadership has been tried and found wanting, either because it had no program or because it lacked the courage to sponsor one sufficiently drastic to stop the deflationary wave. The conclusion is inescapable that we are bound toward further deflation, with perhaps economic chaos and civic disturbances as culminating relief valves to enable the return of normal confidence and to bring forward leadership competent to think and act courageously and effectively.

Individual initiative through fighting and action can prevent the mounting deflationary wave from bringing with it complete disaster. Public confidence, business confidence, financial confidence, investment confidence—these are matters of psychology, and yet they are the essential factors underlying the recovery of normal conditions in this country. Individuals and individual enterprises must get to work with the same degrees of confidence, and even of speculation, that have created present standards. In each industry, and especially in the electrical industry, there are opportunities for work, for sales, for building and expanding, and it will be the united action of individuals in each industry and of industry groups that will create the psychological atmosphere and the business activity necessary to recovery.

To say "the electrical industry can lead the way out of the depression" or "the chemical industry can make prosperity return" are expressions of competent men in these industries who have surveyed possibilities and measured opportunities. They are made in good faith by those who know, and the general public looks to their consummation with great longing and with great confidence that the statements are true. They should be made to come true.

It is time for business men and business enterprises to stop internal economies and to stop piling up cash reserves. Aggressive selling and expansion programs should be undertaken as the better policy and the better business endeavor. Each market should be gone after, each new technological tool should be put to work, each man in industry should act as a promoter instead of a destroyer. All this should be done. Unless it be done and unless the electrical industry, as well as others, gets busy at this work, there is no reason to doubt the continued drift toward complete deflation with its consequent chaos and entire confiscation of capital resources. Why not go down fighting, especially as there is a fighting chance for victory?

Reliability Vies with Economy for System Honors*

JUST where to establish the point of balance between two diametrically opposed criteria of regional power supply was the main theme of four A.I.E.E. papers at this week's annual convention in Cleveland. Assurance of reliability and economical use of physical and capital resources each call for a weighting which in turn fixes the characteristics and the philosophy of operation of such systems as those centering in Chicago, Detroit, Boston and Philadelphia. In some quarters there is the feeling that the need for a high standard of reliability has been overstressed. Detroit's engineers feel that a high price has in some cases been paid for marginal increments above an already high standard. On the other hand, the feeling reported from Chicago is that in periods of depression the efficient units are able to produce a far greater percentage of the total output and the consequent saving in fuel costs more than offsets the increased fixed charges occasioned by the high efficiency.

Long-time aims of system economy have been affected adversely by the slump in loadings. The lesson drawn from the experience of recent months is that more weight than ever must be given to a skillful balance of new outlays against the benefits of high reliability and efficiency. As expressed by A. P. Fugill, it is poor policy to install new facilities before the load has demanded them merely because some added operating economy will result. Boston, according to R. E. Dillon, gives more consideration to the factors of safety and reliability of service than to obtaining the lowest possible investment and operating expenditure. It has never been found profitable to install new facilities ahead of load requirements; the displaced facilities are not displaced in the book values. On the other hand, Messrs. Anderson and Estrada of Philadelphia pointed out that new fixed charges can frequently be deliberately incurred because they will be more than offset by the resultant operating savings. Also, new investment must occasionally be made solely to improve service dependability.

In the case of Chicago there are six closely linked stations with a total of 1,480 megawatts and outlying loosely linked stations with 538 megawatts. In three years the energy brought into the city grew from 8 per cent to 41.3 per cent of the present requirements. It is evident that interconnection has assumed a rapidly growing importance. An interchange energy agreement is administered by a committee of executives supplemented by operating subcommittees. The aim of the agreement is equitably to allocate:

1. Demand charges in proportion to maximum demand of each party.
2. Fixed operating charges in proportion to the maximum demand of each party.
3. Fuel charge in proportion to the kilowatt-hours taken by each party.

Loads scheduled on increment cost basis

In order properly to distribute the loads, ordinarily two load schedules (Fig. 1) for the closely linked stations of the Chicago area and (Fig. 2) for the outlying stations are used. These are revised from time to time to take care of varying conditions, such as seasonal load changes and overhauling of one or more units. The load schedules in Fig. 1 are fundamentally based on the operation of the distant metering system; Waukegan supply of power to Chicago load is not included in the distant metering scheme. The advantage of the distant metering scheme is that the principal stations automatically vary the amount that each generates without having to get telephone instructions from the load dispatcher. They can also to an extent anticipate any departure in the day's load from the usual during the season. This is of distinct value when a sudden storm materially increases the load beyond the usual requirements at the time of the daily noon dip.

The load schedules are based substantially on the comparative increment fuel costs. There are, however, two difficulties in adopting this practice too rigidly:

First—Reserve capacity must be carried at strategic points of the system to take care of emergencies.

Second—During the early hours of the day, from midnight to 4 a.m., and on Sundays and holidays it is desirable to keep all major stations on the system with some load. There are certain minimum practical loads that must be carried independently of the economics of the situation.

Powerton has 33 per cent advantage

The comparative increment cost per kilowatt-hour varies with the station net output in megawatts for each of the five most recent stations (Fig. 3). The proportionate cost of coal per B.t.u. also varies. The stations near Chicago have substantially the same cost of coal per B.t.u., but between the lowest value of the adjacent stations and the Powerton station, the most distant, there is a difference of 15 per cent in favor of Powerton. Consequently, in comparing the increment fuel consumption of the Powerton station with the adjacent stations not only must consideration be given to the very low fuel consumption for additional loads but, in addition, the advantage in lower fuel cost must be taken into account. Neglecting the question of transmission for the moment,

*Abstract of symposium on "Combined Aspects of Reliability and Economy in the Operation of Large Electric Systems." By L. L. Perry and F. V. Smith, Sargent & Lundy, Inc., Chicago; A. P. Fugill, Detroit Edison Company, Detroit; J. W. Anderson and Herbert Estrada, Philadelphia Electric Company, Philadelphia; R. E. Dillon, Edison Electric Illuminating Company, Boston.

it is seen that Powerton has an advantage of 33 per cent over Waukegan in carrying an additional 10,000 kw.

The saving in costs due to more economical generation is, of course, partly offset by transmission losses. With all fixed charges of transmission to be paid in any event under rental agreements, the increment line loss on Powerton power can be as high as 33 per cent and the power delivered from Powerton to Waukegan, a distance of approximately 240 miles, will still have a production cost the same as that generated at Waukegan. If the intermediate load is 60 megawatts with the increment loss of 33 per cent, more than 60 megawatts can be delivered to Waukegan with the same fuel cost as that generated at Waukegan. This is slightly below the reasonable stability limit and, under ordinary conditions of operation, will be beyond the generating capacity available at Powerton. Similar studies show it is economical to send power through the State Line station into Chicago.

Usually, then, the limit to the amount of power coming into Chicago is not the economics of the situation, nor the stability of the lines delivering this power, but instead, in the present condition, is the capacity available at Powerton for Chicago load. Within the limits of the stations adjacent to the city of Chicago—that is, from Waukegan to Michigan City—the increment line loss is usually not an important factor.

B.t.u. rate down to 13,000

In 1931 the Chicago territory as a whole produced its power at an average B.t.u. per kilowatt-hour send-out of 15,006. Of this power 85.8 per cent was produced in stations with an average B.t.u. of 13,910. The capacity of these stations was 58.3 per cent of the total. Older stations produced only 14.2 per cent of the power with an average B.t.u. per kilowatt-hour send-out of 21,603, but they contributed only 41.7 per cent of the total requirements. Illinois coal runs 12 to 15 per cent in ash and 12 to 15 per cent in moisture.

Beginning with the installation of 300-lb. steam tur-

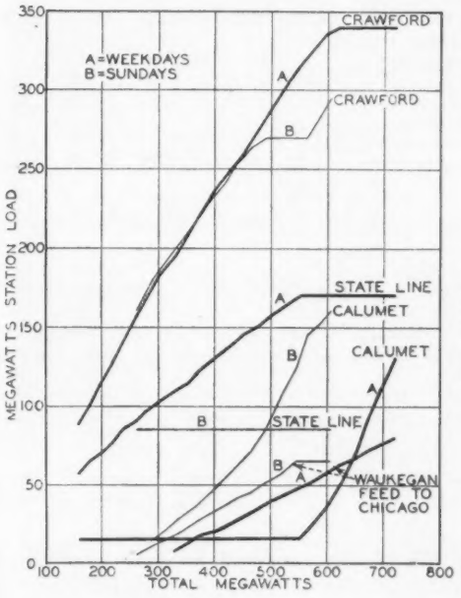


Fig. 1—State Line and Crawford scheduled for big share of Chicago loads

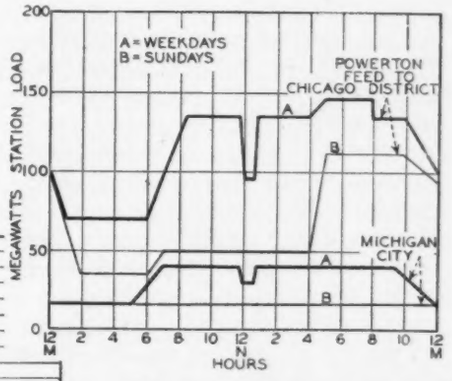


Fig. 2—Powerton operated at high load factor

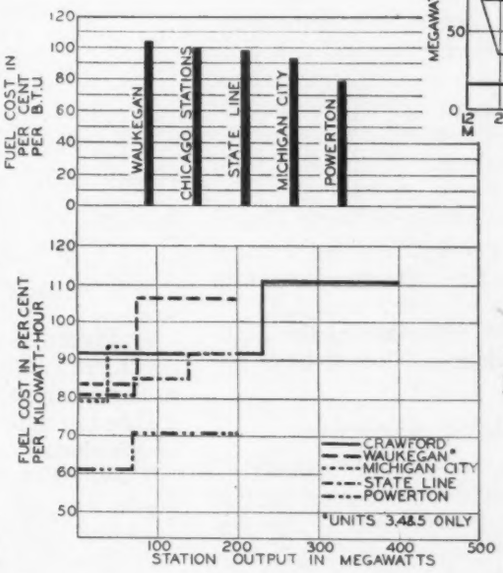


Fig. 3—Powerton has lowest increment fuel cost

Fig. 4—Most efficient stations carry bulk of load

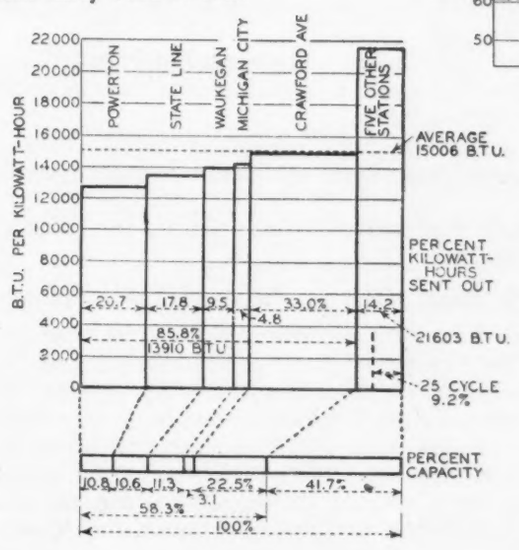
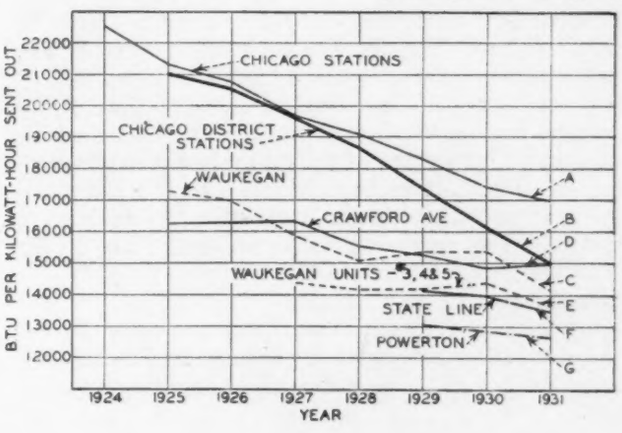


Fig. 5—B.t.u. rates make good gains in eight years



bines at Joliet in 1917, the principal factors that have improved the thermal efficiency in the district are the following:

1. Increased steam pressure.
2. Increased steam temperature.
3. Reheat.
4. Regenerative cycle.
5. Pulverized coal furnaces.

The relative improvement due to the advance in turbine and boiler design is shown in the case of the State Line station. Change from chain grate stokers to pulverized fuel equipment, together with the 4.5 per cent improvement in turbo-generator efficiency, made a total gain in efficiency of 10.4 per cent, reducing the B.t.u. per kilowatt-hour send-out for a period of a month or longer from about 14,500 to about 13,000. The 1,200-lb. units on order will have a turbo-generator efficiency of about 11.5 per cent better than the No. 1 unit and the expected over-all B.t.u. per kilowatt-hour will be reduced from 13,000 to 11,500.

The 600-lb. stations (Table I) ran at an average capacity factor in 1931 of 53.2 per cent and produced the average kilowatt-hour send-out for 13,900 B.t.u. The savings in fuel costs have been made up in the table with a variety of coal costs, so that the effect of changes in this figure will be apparent. The table gives the saving in the 600-lb. station as compared with a 350-lb. station on a capacity factor of 53.2 per cent. Also, it is apparent that as the 600-lb. equipment gets older it will naturally run at a lower annual capacity factor, but there seems to be no reason to believe that during its useful life its capacity factor in a large interconnected system need be less than the average in the Chicago system for the last ten years. That figure was 39.5 per cent. Therefore, the savings per year over its life should be at least from $1.18 to $2.36 per kilowatt, justifying the expenditure to obtain this of from $10.75 to $21.50 per kilowatt (based on 11 per cent fixed charges), and still give the same total over-all cost of power. Still greater economies than those outlined are expected from the 1,200-lb. equipment now on order for the extension to the State Line station, which should produce a kilowatt-hour for 11,500 B.t.u.

Table I—1931 Operation of 550-650-Lb. Units in Chicago Area

Station	Million Kw.-Hr. Sent Out	Thousand Kw. Capacity	Capacity Factor	B.t.u. per Kw.-Hr. Sent Out
Crawford Ave.	1,880.4	424	50.6	14,914
Powerton	1,173.9	204	65.5	12,679
State Line	1,009.5	200	57.5	13,446
Waukegan	535.0	153.3*	31.9	13,890
Michigan City	269.8	58.5*	52.4	14,238
	4,868.6	1,039.8	53.2	13,900

* Average. One unit began service during year.

B.t.u. per kilowatt-hour, average					13,900
B.t.u. per kilowatt-hour on 350-lb. units					17,500
Gain in 550-650-lb. units, B.t.u. per kilowatt-hour					3,600
Coal, B.t.u. per pound					10,500
Gain in pounds coal per kilowatt-hour					0.343
Coal cost, dollars per ton	2.00	2.50	3.00	3.50	4.00
Capacity factor 53.2 per cent (average of 550-650-lb. units)					
Hours' operation	4,700	4,700	4,700	4,700	4,700
Savings per kilowatt per year	$1.61	$2.02	$2.42	$2.82	$3.22
Permissible increased investment per kilowatt at 11 per cent fixed charges	14.70	18.40	22.00	25.70	29.40
Capacity factor 39.5 per cent (average of Chicago district)					
Hours' operation	3,460	3,460	3,460	3,460	3,460
Saving per kilowatt per year	$1.18	1.48	1.78	2.08	2.36
Permissible increased investment per kilowatt at 11 per cent fixed charges	10.75	13.45	16.13	18.90	21.50

Table II—Method of Load Allocation Used in Detroit

Plant	Active Generator Capacity in Mw.	Active Generator Capacity in per Cent of Total	Coal Rate in Lb. per Kw.-Hr.	Col. 2, Col. 4,	Load Allocation in per Cent of System Load: Approximate	Load Allocation in per Cent of System Load: Actual
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Delray	110	15.3	1.12	98.2	15.3	20
Connors Creek	150	20.8	1.45	103.2	16.0	20
Marysville	160	22.1	1.07	149.7	23.3	19
Trenton Channel	300	41.6	1.03	292.1	45.4	41
Total	720			643.2	100.0	100

Isolated phase and metal-clad gear proved

The most outstanding developments from the electrical point of view in the Chicago territory have been the use of isolated phase and metal-clad switchgear. The importance of the Crawford Avenue station to the district made advisable the further use of the isolated-phase principle, which had first been used at Calumet. This is now applied throughout the Commonwealth Edison system not only to 12-kv. equipment but also to 66-kv. outdoor equipment. The record of the Crawford Avenue station has in the seven years of service demonstrated that a high degree of reliability has been attained by its use. Faults have been confined to the phase-to-ground type in both 12 kv. at the station and 66 kv. on the system. The following points in design are to be noted as important factors in this record:

1. Fault bus protective scheme.
2. Reactors in all connections from generator buses.
3. Phases isolated at generator voltage and 3-ohm resistor in the neutral connection of one generator at a time.
4. Phases isolated at 66 kv. with circuits of single-conductor underground cable and 30-ohm resistor in transformer neutral.

The last four years have also seen a rapid application of metal-clad switching for 12 kv., 22 kv., 33 kv. and 132 kv. The chief advantages of metal-clad gear are the following:

1. Personal hazards are practically eliminated.
2. The metal-inclosed buses reduce the possibility of phase-to-phase shorts.
3. Outdoor equipment eliminates building costs.
4. Factory-assembled equipment reduces installation costs.
5. Fault bus protection is applicable for quick clearing of faults.

No doubt about feasibility of 220-kv. cable

Experience with high-tension cable in Chicago has shown that very satisfactory performance can be obtained with hollow-core, oil-filled cables as used on 132 kv. in service since 1927 or solid-core, single-conductor cables provided with oil-pressure reservoirs on 66-kv. cable in service since 1926. The use of oil reservoirs has also been adopted on the 22-kv. single-conductor cables at Powerton and State Line since they form part

of the generator bus. It was felt that the additional cost was small and maximum reliability was essential. No cable failures have been experienced at either of these stations. On all the 66-kv. cables in Chicago a reliable pilot-wire protection scheme is used which opens the breakers at both ends of the line simultaneously in case of unbalanced ingoing and outgoing current in the line.

The fundamental in planning for system reliability is to operate in such a way that trouble in one section will not be allowed to spread to a large area and also to provide sufficient reserve capacity to take care of any emergency. The basic scheme which has been used in feeder arrangement has been a natural consequence of the isolated-phase idea. While in the station the various phases are kept separate, so that trouble will not spread from one to another, in the system the transmission lines are divided into several sections so that one can be lost without affecting the load. In Chicago the 66-kv. cable system extending through the city from north to south is divided into two groups, which are kept quite separate on the 66-kv. side and tied together only on the low-tension side of the step-down tranformers at the various distribution centers. This means that the load will never lose supply, and trouble that might occur on one 66-kv. bus at any station will involve only part of the system.

Reserve practically independent of system load

It is estimated that the maximum loss of generating supply to Chicago would occur from the interruption of one of the lines from Waukegan to Chicago. This would involve not only the loss of the machine on that line at Waukegan but also the feeds coming through Waukegan from Powerton. This would be a maximum of about 90 megawatts, which is little different from the loss of the largest unit within Chicago itself. Arrangements are made to have this amount of reserve capacity running in the stations of the district so that the load can be picked up without difficulty. The total reserve is thus practically independent of the load on the system; it is dictated more by the size of generating units and tie lines. In all recent units the most economical point of operation is about three-quarters load, so that a reserve is available without loss of efficiency. On one occasion in which the entire supply from Waukegan and the two Powerton feeds into Chicago was lost the load was picked up with a momentary drop in frequency of only 4/10 cycle and no interruption in service to customers at any point.

Summarizing other conclusions drawn from the report on the Chicago system:

1. The most efficient types of equipment should be installed as rapidly as they become commercially available.
2. For any power station for a large interconnected system there is a standard below which sacrificing efficiency produces no improvement in reliability and reducing fixed charges at the expense of operating efficiency will increase the over-all cost of energy. Furthermore, as manufacturing technique improves, this standard is continually advancing.
3. There has been a marked gain in economy by increasing steam pressures and temperatures without reduction in reliability.
4. The experience with the 132-kv. cable indicates that 220-kv. cable of ample reliability is feasible, so that in the choice of underground cable the economics rather than doubt about reliability will dictate the choice of voltage.
5. With modern overhead steel-tower transmission lines, well constructed with low-resistance grounds, reliable ground wires and co-ordinated relay protection, experience has shown that increasing amounts of power can be transmitted without decreasing the reliability of supply to the distributing centers.
6. Totalizing schemes for load dispatching are of considerable assistance in efficient operation of the system.
7. Automatic frequency control is a distinct advantage in conjunction with distant metering in enabling individual stations readily to adhere closely to predetermined schedules.

Detroit follows conservative policy

It is the general policy of the Detroit Edison Company to be reasonably conservative in the application of facilities on the basis that an increased reliability of equipment results. In determining the capacity to be installed the design is such that the equipment does not need to be crowded to the very limit of its output for a reasonable emergency. This is particularly true of items such as boilers, which are especially affected by overloading. Advantage is taken in emergencies of the inherent short-time overload capacity of certain equipment when it is felt that such operation does not reduce its reliability. For instance, transformers and induction regulators are permitted to operate at higher than their nameplate rating for a short-time peak-load period in an emergency.

In general, a voltage insulation standard higher than the minimum acceptable has been adopted because of its important bearing on equipment failure. For example, cable insulation is thicker than usual, the bus insulators and bushings on transformers and breakers are the next higher voltage class, and clearances to ground and between phases are greater than the minimum standards.

Realizing that circuit breakers are by far the most hazardous piece of electrical equipment involved in the station design, they have been eliminated wherever possible. Thus in distribution stations fed at 24 kv. the cable and transformer are considered as a unit, being switched on the high-voltage side of the transformer at the sending station only. Where it is impossible to eliminate breakers in the 24-kv. indoor stations a type with a minimum of oil is used on the basis that the real hazard is the large quantity of oil in the tanks.

Allocation a compromise between economy and practicability

To obtain the most economical operation each load should be supplied from the power house which gives the lowest delivered cost of power including production and transmission costs. With the scheme of operation adopted by the Detroit Edison Company the loads on the machines at a plant and on the tie lines into the plant must be maintained at such a point that the area load can be carried in case one machine trips out, the largest being assumed out of service for maintenance. To obtain economical loading on the machines this requirement usually results in the transmission ties being underloaded. The method of allocation used is a compromise between maximum economy and practical operating conditions. It is based on the station capacity weighted by the production economy and modified to take account of the physical loads and the method of operation.

In applying the method, the active capacity at each plant is divided by the plant coal rate in pounds per kilowatt-hour. Then, as a first approximation, the percentage load on each plant is determined on the basis of these weighted figures. A modification is introduced to take into account the transmission loss. If this allocation does not meet the requirements of practical operation it is further modified to take this factor into account. A specific example will explain the method more clearly:

In Table II recent data for the four plants are listed. The active installed capacity at each plant is given in megawatts

in column 2 and in per cent of the total in column 3. Column 4 shows the coal rate in pounds per kilowatt-hour. Dividing the plant capacity in column 2 by the plant coal rate in column 4 gives column 5. Totaling these weighted figures and dividing each item by the total gives the approximate allocation of column 4. This percentage takes into account the effect of differences in production costs, but does not include the effect of transmission loss. It happens that the load allotted to Connors Creek and Delray in this case is only about 75 per cent or less of the area loads of these plants. If the cost of transmitting the remainder of these loads from the suburban power stations into the city load areas is considered, the city plants should carry a larger percentage of the total load. In addition, the advisability of the transmission ties for emergency relief would also dictate a greater load on these stations. Without going through the detail procedure in this particular case, these factors indicated that 20 per cent each should be carried on Connors Creek and Delray. The actual load allocations are given in column 7.

Philadelphia cuts fuel 16 per cent

The reliability of production facilities of the Philadelphia Electric System is indicated by an analysis of the factors affecting customers' service. In 1931 no interruptions to customers' service were caused by failure of production facilities. The operating economies obtained have resulted in a steady reduction in fuel rate per kilowatt-hour, the following values for succeeding years being expressed in per cent of the 1926 value as a base:

Year	System Coal per Kw.-Hr., Per Cent
1926	100
1927	97
1928	99
1929	93
1930	89
1931	84

The only new and more efficient generating capacity added during the entire period was Deepwater station, the Philadelphia Electric Company's share of which amounts to only 8.4 per cent of the total system steam capacity.

The effect of economical load and reserve allocation is indicated by the following tabulation showing the B.t.u. per net kilowatt-hour for various steam stations expressed in per cent of the steam station B.t.u. rate for the year 1931:

Stations	Per Cent of System B.t.u. Rate	Per Cent of Total Steam Capacity	Per Cent of Total Steam Generation
Deepwater	78	8.4	24.8
Richmond	88	17.4	36.4
Delaware	115	26.6	22.0
Chester	120	18.3	12.1
All other steam stations	183	29.3	4.7
Steam system	100	100	100

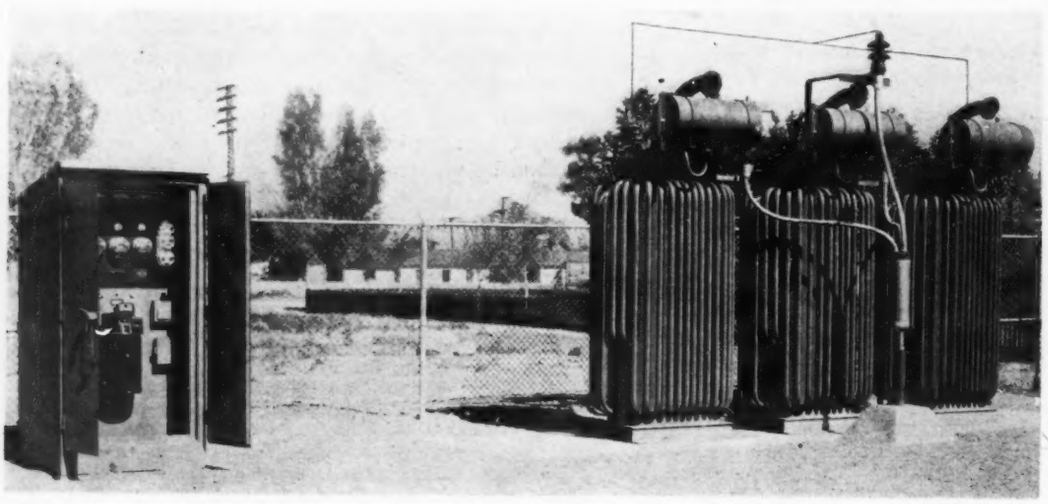
These results have not been obtained at the expense of abnormally high carrying charges. All facilities installed to increase operating economy have been required to show operating savings in excess of fixed charges.

A comparison of the total operating cost per kilowatt-hour covering generating stations, substations and purchased power in the Boston area for the years 1920 and 1930 shows that a reduction of 62.3 per cent has been effected by all the contributing factors. Whenever changes of particular equipment were advised a large gain had to be assured in order to win approval for the change, and in all cases which were approved the figures left no question or doubt. Most careful consideration has always been given to the problem of replacing capacity solely for better operating economy. Many replacements have been made in past years, but at the present time none can be justified because fixed charges that would be incurred on new equipment prove equal to a very large percentage of the total cost of operating the old equipment.

▼ ▼ ▼

Neat, Compact Substation Serves Low-Density Area

Designing to meet the needs of a lightly loaded distribution area, the engineers of the Sierra Pacific Power Company, Reno, Nev., have met the demand for quality service at low investment cost with the unit-type construction illustrated herewith. Eliminating all steel framework, this design includes the use of unit-type switch house now on the market and underground primary and secondary connections. Transformers are mounted on concrete pads, the secondary leads being carried underground to the automatic reclosing oil circuit breaker housed in the compartment shown on the left. Relays and meters are included as a part of the oil circuit breaker installation.



The substation is surrounded by a wire fence and with this design the hazard from exposed live parts is practically eliminated. In addition to ease of installation, the substation has a high salvage value when load growth in the surrounding area justifies more elaborate facilities.

Telemeter Uses Tubes and Standard Instrument Parts*

By A. J. JOHNSTON
General Electric Company, Philadelphia, Pa.

IT IS now possible, by means of the torque balance telemeter, to indicate or record up to a distance of 100 miles the value of such quantities as watts, amperes, volts, temperature, pressure and flow with instrument speed and accuracy. The value of direct current which is used as the translating means of the telemeter is well within the limits of voltage, current and noise units stipulated by the telephone companies. The telemeter automatically compensates for variation in line-wire resistance, auxiliary supply power voltage and variation in tube characteristics. In general, the torque balance telemeter approaches, in almost all respects, the requirements of the ideal telemeter.

The receiving and indicating apparatus of the torque balance telemeter is one and the same device, referred to as the receiver. Likewise, the measuring and transmitting apparatus is a single unit, referred to as the transmitter. The measuring element may be one of two general classes, depending upon the quantity to be measured. Pressure gages and Selsyn motors are classed as the position type and voltmeters, ammeters and wattmeters are classed as the torque type. Of these only the wattmeter will be discussed in detail in this paper.

The receiver may be any form of indicating or recording direct-current milliammeter. If desired two or more receivers may be operated in series by one transmitter. Likewise, when it is desired to totalize the values of two or more quantities the transmitters may be connected in parallel to a single receiver.

The transmitter is composed of four major parts, the measuring or operating element, the balancing or restraining element, the universal coupling and the electron tube circuit.

The operating element is a standard indicating wattmeter, except that the control springs, pointer and damping disk are removed and a yoke is fastened to the shaft of the element to provide a means of coupling it to the shaft of the restraining element. Lead-in spirals are provided to supply electrical connections to the moving coils.

The restraining element in all cases is a standard permanent magnet direct-current milliammeter, except that the control springs are replaced by lead-in spirals and the pointer is replaced by a pin to provide a coupling to the operating element.

The connecting yoke, upon which an instrument mirror is mounted, is supported at the top by means of the pin which is fastened to the shaft of the restraining element, being free to move about the axis of the pin. The bottom prongs of the connecting yoke hang free through a loop of silk thread supported by prongs of a second yoke which is fastened to the shaft of the operating element. Thus a flexible insulated universal coupling is formed between the two elements. The total weight of the connecting yoke and mirror is 1.25 grams.

The electron tube circuit consists of a pliotron, two photo-electric tubes and an auxiliary power supply transformer. The photo-electric tubes, which are of the gas-filled type, are connected in series across one secondary winding of the transformer with their common junction connected to the grid of the pliotron. The plate of the pliotron is connected to a second secondary winding of the transformer through the restraining element and receiver. Two other secondary windings supply voltage to the filament of the pliotron and lamp bulb.

The pliotron filament, which is of the thoriated tungsten type, is rated at 7.5 volts and the plate current is rated at 28 milliamperes. However, the transmitter is designed to operate the filament at 6.5 volts and to require not more than 10 milliamperes from the plate. The photo tubes are also operated below their normal rating of 20 microamperes. Approximately six microamperes circulate in this circuit. Likewise, the lamp bulb is operated at 3.9 instead of 6 volts. This insures a life of approximately one year for the tubes and lamp. The total auxiliary power consumed by the telemeter is approximately 40 watts.

Compensated for all circuit variations

Of primary importance in the design of any electron tube circuit for use with measuring apparatus is self-compensation for changes in tube characteristics. The circuit employed in the torque balance telemeter is not only compensated for changes in tube characteristics but also for changes in auxiliary power supply voltages and line-wire resistance.

Variation in auxiliary supply voltage affects the current output of the electron tubes as well as the illumination of the lamp. If the voltage is reduced there will be a reduction in the torque of the restraining element, which will cause a movement of the shaft in the direction of the torque of the operating element. This movement will increase the light on the right-hand photo-electric tube. The shaft will take up a new position at a point where the increased light on the right-hand photo-electric tube will sufficiently reduce the grid bias on the pliotron to allow it to pass the original value of current. The action is, of course, reversed when the supply power voltage is increased.

Changes in electron tube characteristics will occur very gradually. However, the compensation for this change is accomplished in exactly the same way as for changes in supply power voltage. As long as the electron tubes are capable of passing sufficient current to balance the restraining element against the full load torque of the operating element and to prevent any current from flowing when there is no power in the operating element the tubes are satisfactory for service.

Changes in line-wire resistance are compensated for in the same manner. The shift of the light on the photo-electric tubes has the effect of changing the pliotron plate resistance by an amount equal and opposite to the change in line-wire resistance.

Changes in illumination due to dust on the lens and mirrors or to deterioration of the lamp filament are fully compensated for as long as enough light strikes the photo-electric tubes to give them control of the pliotron. The commercial models will operate on considerably less than 50 per cent normal illumination.

The sensitivity and responsiveness of the telemeter is

**Abstracted from paper "The Torque Balance Telemeter," presented at A.I.E.E. summer convention, Cleveland, Ohio, June 20-24, 1932.*

comparable to that of the usual line of switchboard instruments. Field tests have shown that the transmitter and receiver together actually respond more quickly than an indicating wattmeter connected directly to the measured source in spite of the fact that the responsiveness of the receiver is in the order of 2 seconds, while the responsiveness of the indicating wattmeter is in the order of 1.5 seconds. This can be explained by the fact that there is no damping in the transmitter circuits and that the moving system has to move not more than 3 deg. to cause a change in the line current from zero to maximum. Laboratory tests show that the line current reaches a maximum value, which is in the order of twice full scale current, approximately one-tenth second after full scale power is suddenly applied to the operating element and that the line current is settled down to a steady value within one second. Thus the receiver is accelerated rapidly during the first half second.

Charts taken in a field test show conclusively that the receiver is capable of recording any changes that could be recorded by the local wattmeter.

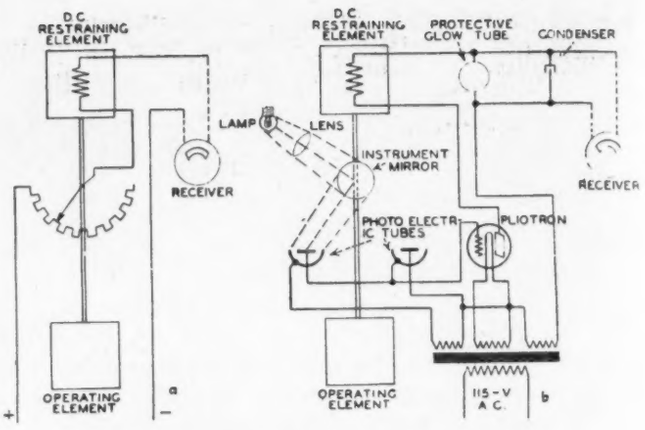
The accuracy of the transmitter is usually given the same as a standard switchboard type indicating instrument; i.e., "1 per cent of full scale." The complete telemeter is theoretically capable of very high degrees of accuracy. This is especially true when the receiver is calibrated with the transmitter, because the receiver scale can be marked directly in terms of the values of power in the measured source.

The scale of the receiver is directly proportional and is therefore more easily read than the scale of a standard wattmeter. It will be recalled that the moving system of the transmitter has a maximum deflection of approximately 2 deg. and that the current field of a wattmeter is practically uniform over that range. Thus the torque produced by the operating element is directly proportional to the watts in the measured source. This feature is very important because it allows the telemeter to be readily used for totalizing alternating-current watts or any other quantity which will produce a torque in the operating element directly proportional to the measured quantity. Some operating elements, such as alternating-current ammeters, do not have a direct proportion between current and torque even though the shaft is allowed to turn through only a narrow range.

Line leakage can also be compensated

The factors which are most likely to affect the accuracy of the telemeter are line leakage, bearing friction and balance of the transmitter moving system. Line leakage is, in effect, a shunt across the receiver. If the leakage resistance is constant it can be compensated for by calibration, but if the leakage resistance is variable the percentage error introduced will be directly proportional to the percentage of current shunted from the receiver. Line leakage can be expressed in general as directly proportional to length of line and inversely proportional to leakage resistance. The calculated error due to leakage in 100 miles of No. 19 B & S gage open line wires is less than one-tenth of 1 per cent. The calculated error for 100 miles of No. 8 B & S gage open line wires is less than 5 per cent when the receiver is an indicating instrument. This calculation is based on wet weather conditions, estimated to occur one day out of one hundred. During dry weather the error is negligible.

Bearing friction is present in any type of instrument,



Pliotron tube provides requisite range of infinite resistance

(a) The fundamental circuit consists of an operating element, restraining element and a receiver. The receiver is a standard direct-current milliammeter. For purposes of discussion it will be assumed that the rheostat, which is operated by the common shaft of the operating and restraining elements, is frictionless, has a resistance range from zero to infinity and requires an armature movement of 2 deg. to cover the complete range. The restraining element is connected in series with the receiver and the rheostat to a direct-current source. The potential is so chosen that the restraining element torque is in opposition to the operating element torque. Since the control springs are removed from both elements, the restraining element torque is the only force opposing the movement of the operating element. Such a circuit is completely self-compensating for changes in potential of the direct-current source and resistance changes of the line wires, because the torque of both elements must always be equal and opposite. Any change in the circuit destroying this balance would cause a movement of the shaft and rheostat armature in the proper direction to re-establish the balance. From the foregoing it will be seen that there is no definite position of the moving system for a given measured quantity. Thus, neglecting bearing friction and line leakage, the deflection of the receiver is a true measure of the quantity being measured by the operating element.

(b) A photo-electric circuit and optical system are actually used in the torque balance telemeter in place of the rheostat of (a) as a means of maintaining a balance between the two elements. The optical system is so arranged that light from the lamp source is condensed by a 25 diopter plano convex lens on a stationary mirror, which reflects it to the instrument mirror mounted on the connecting yoke, and thence to the photo-electric tubes. The photo-electric tubes are placed so that the beam of light may fall entirely on either tube or may fall partially on both tubes. The constants of the circuits are such that when light is falling only on the left-hand photo-electric tube the grid potential is increased sufficiently to bias the pliotron to cut-off; in other words, the pliotron has infinite resistance. When all of the light is falling on the right-hand photo-electric tube the grid potential of the pliotron is reduced to a point where the plate resistance is approximately 10,000 ohms, thereby permitting a plate current of more than 10 milliamperes through a total external loop resistance of 8,800 ohms. When the light beam falls anywhere between these two extremes the pliotron resistance accordingly will be somewhere between the extremes of 10,000 ohms and infinity. Thus, since the light beam has no inertia the optical system and electron circuit form a frictionless rheostat.

When the telemeter is used with external resistance less than 3,500 ohms the transformer is used to supply power directly to the tubes. In this case the translating means is half-wave rectified alternating current. A condenser is connected across the line wires at the transmitter to smooth out the wave.

When the external resistance is more than 3,500 ohms full wave copper-oxide rectifiers are inserted to supply direct current to both the plate and grid circuits of the pliotron. This addition is made to reduce the peak values of the voltage impressed on the line wires.

and since the transmitter is composed of standard instrument parts it has no more effect than in standard indicating instruments.

Proper balance of the transmitter moving system is very important if the telemeter is to be perfectly self-compensating. It must be free to move throughout its entire range so that the current in the restraining element will be exactly the same for balancing a given torque of the operating element regardless of the position of the moving system. No trouble in obtaining a satisfactory balance has been experienced in the commercial models.

The foregoing discussion applied only to the transmitter for measuring single direction watts. When it is desired to measure directional quantity, such as positive and negative watts, a second pliotron is added to the transmitter in such a way as to make the circuit function as a frictionless voltage divider instead of a directional rheostat, so that positive and negative values of current can be used as a transmitting means. In this case, of course, the receiver is of the zero center type. When designed to measure such quantities as pressure or the position of a Selsyn motor, the position of the gage or selsyn motor is converted into torque by means of spiral springs. For measuring temperature the restraining and operating elements are combined into a single unit, which is a standard differential type temperature instrument.

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Economics of 300-Mile Multiple-Conductor Line

Specific evidence as to the cost of multiple-conductor line applications in high-voltage transmission was presented recently before the A.I.E.E. district convention in Providence, R. I., by W. W. Lewis of the central-station engineering department, General Electric Company. A study was made of a system designed to deliver 500,000 kw. over a distance of 300 miles. Split-conductor 345-kv. and 230-kv. lines were considered and compared with conventional lines of the same voltage. The power limit of each arrangement was on the basis of steady state stability.

With the split conductor, 345-kv. line two conductors were used per phase, each 1,192,500 circ-mil A.C.S.R. Various spacings between conductors and between phases and various lengths of span were considered and the most economical arrangement adopted. This line would carry 500,000 kw. The investment, including line, step-up and step-down transformers, synchronous condensers, switchgear and substations, was $48.40 per kilowatt and the yearly charge $7.90 per kilowatt. Two conventional lines (one conductor per phase) for 345 kv. would carry 660,000 kw. and entail an investment of $49 per kilowatt and a yearly charge of $7.60 per kilowatt.

Two split-conductor, 230-kv. lines would carry 470,000 kw. at an investment cost of $63.30 per kilowatt and a yearly charge of $10.70 per kilowatt. Four conventional 230-kv. lines would carry 600,000 kw. at an investment cost of $64.20 per kilowatt and a yearly charge of $10.50 per kilowatt.

From these figures it appears that at 345 kv. two conventional lines have about the same cost per kilowatt and same yearly charge as one split-conductor line. The two conventional circuits have a greater total capacity and have the obvious advantage that the total flow of power is not dependent upon one tower line. At 230 kv. the cost per kilowatt and the yearly charge on two split-conductor lines and four conventional lines is about a toss-up. However, the capacity of the two split-conductor lines is somewhat less than required in this particular case, while the four conventional lines have a considerable margin in capacity.

The conclusion was that since the split-conductor line is untried in practice and has certain constructional and operating disadvantages, with no compensating advantage in cost, it seems desirable for the present to adhere to conventional designs.

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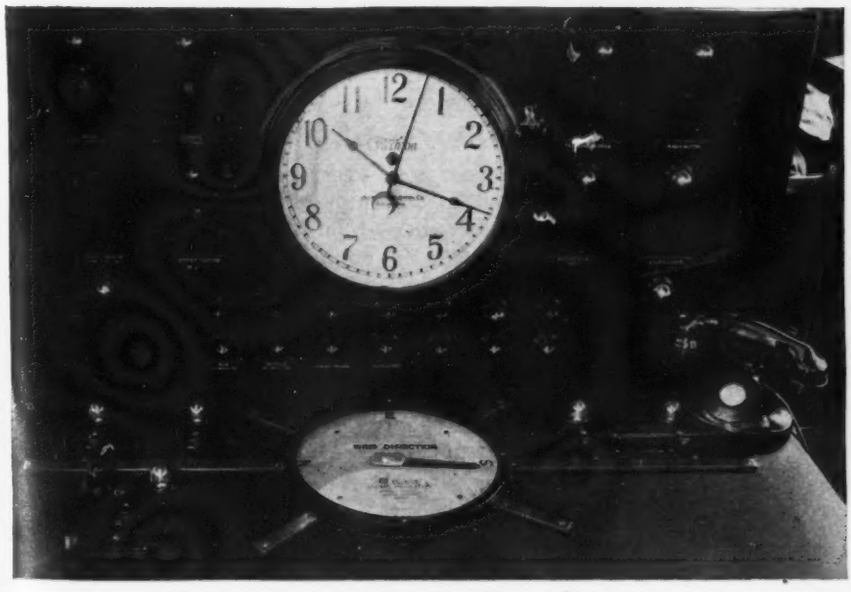
Benchboard Facilitates Airport Dispatching



By adopting the central-station practice of using a bench-type control board, dispatchers at the Sacramento municipal airport, Sacramento, Calif., are provided with a convenient means of controlling the various electrical circuits controlling airport facilities. The close supervision of floodlights, emergency lights and warning signals attendant to the safe arrival and departure of airplanes has been incorporated in the compact, bench-type switchboard and control station shown.

Control circuits for obstruction lights, warning siren, street lights, field floodlights, hangar lights and beacon are operated from small tumbler switches mounted on the control board, each circuit being provided with indicating lamps, from which the dispatcher can ascertain if circuits are functioning properly.

One of the newest features is the Selsyn-operated wind direction indicator, which aids the dispatcher in signaling incoming planes to the runway offering the most favorable landing condition.

Relays Operated from Bushing Potential Devices*

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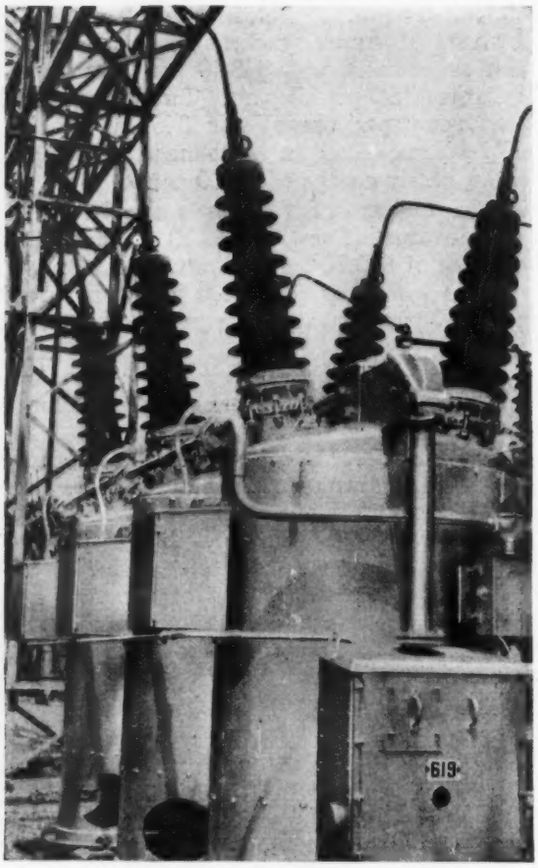


Fig. 1—Breakers equipped with condenser bushing potential devices
Used on the 66-kv. system of the Virginia Public Service Company for synchronizing, relaying (type CR3) and voltage indication.

FIELD experience over the past four years establishes the condenser bushing potential device as a reliable and adequate source of potential for relaying of high-voltage systems. The potential device utilizes the inherent voltage-divider characteristics of standard condenser bushings used in high-tension circuit breakers and transformers. This device, originally developed for synchronizing across high-voltage breakers, will function properly with overcurrent directional relays, voltage relays and distance relays applied within the burden rating.

The device depends for its operation on the charging current through the condenser bushing acting as an electrostatic voltage divider. It consists essentially of a potential transformer having reactance and capacitance in its secondary circuit which furnishes a voltage suitable for instrument use, substantially in phase with and proportional to the line-to-ground voltage of the system. A protective gap shunted across the high-voltage winding of the transformer protects against overvoltage surges. The component parts of the device are contained in a weatherproof housing suitable for installation on circuit breakers and transformers (Fig. 1). The electrical connection is made to the bushing tap by means of a short, flexible, weatherproof cable properly protected and insulated to withstand maximum voltage conditions to which it may be subjected.

Protection of high-voltage systems is usually considered to be more effective when the relays are energized by potential transformers directly connected to the high-voltage conductor. Economical requirements in the past have dictated the use of potential from the low-voltage side of power transformers with attendant complications and inaccurate results. For instance, in the case of impedance relays, the use of the low-tension bus potential requires the use of a compensator to correct for the voltage drop through the power transformer and in some cases for the apparent shift of the system neutral. Furthermore, in the application of the higher speed relays, compensating schemes are practically impossible on account of the transient phenomena occurring during the first few cycles incident to system faults. By using a potential device in conjunction with the circuit breaker condenser bushing an economical source of low-voltage potential is provided directly from the high-voltage system, thus permitting the use of the more desirable schemes of relay protection. A review of the requirements of some of the typical schemes utilizing voltage for relay protection indicates the effectiveness of this device.

Field tests show practicability of bushing device

During the past four years numerous field tests have been conducted to determine the practicability of relay operation from condenser bushing potential devices. A series of tests for contemplated installation were conducted on the 132-kv. grounded neutral system of the Public Service Electric & Gas Company of New Jersey in September, 1928, and October, 1929. These tests were made at the Metuchen high-voltage laboratory and at the West Orange switching station to determine the performance of condenser bushing potential devices for ground fault protection. Three devices were installed on a 132-kv. G-22 breaker and individually adjusted to energize a 15-volt-ampere burden at 110 volts and zero

**Abstract of paper presented at A.I.E.E. summer convention, Cleveland, June 20-24, 1932.*

phase error. Since the primaries of the potential devices are inherently connected star it was only necessary to connect the secondaries in delta to provide residual voltage for ground relaying. Using a type CR relay in the corner of the broken delta, the following group of tests were performed:

(a) To simulate a severe line-to-ground fault near the station the voltage on one phase was reduced to zero. Normal voltage was maintained on the two other phases.

(b) Simulating a high-resistance fault the voltage on one phase was reduced to one-half normal voltage. Normal voltage was held on the two other phases.

(c) Simulating a three-phase fault at the far end of a long line the phase voltage on all three phases was reduced to one-half normal voltage.

(d) Determination of phase-angle range over which secondary voltage could be shifted.

The tests on this system show that the performance of the potential device under normal conditions is quite similar to the usual high-voltage transformer arrangement. Under fault conditions, however, the results deviate somewhat from expected potential transformer performance. For instance, Fig. 2 illustrates the vector relations of the potential device voltages when one phase voltage has collapsed to zero as the result of a low-resistance fault. The residual voltage is shifted in the direction of the fault current. This condition inherently produces better relay performance because the angle between the residual voltage and residual current is reduced, resulting in greater relay torque. Further improvement of relay performance was obtained by arbitrarily adjusting the device to have an initial phase displacement of 10 deg. leading. Similar results were obtained for the high-resistance faults except that the phase shift of secondary voltage was not as great.

Under conditions of a three-phase fault at the far end of a line no residual voltage appears on the relay. Each of the three potential device voltages is equally shifted somewhat from true position, although the 120 deg. relation between devices is not affected. These tests demonstrate that potential devices can be connected in delta to energize a common burden without the existence of circulating currents or the incorrect vector addition of the phase voltages. Also, improved relay performance can be obtained by using the device to compensate for the phase shift between residual voltage and current of the system.

Vector relations of three delta-connected devices energizing a ground relay under conditions of a bus single-phase solid metallic fault to ground (Public Service Electric & Gas tests).
$E_x - E_y - E_z$ = Potential device secondary voltages.
E_r = Residual voltage.
I_r = Residual current.
E_{ref} = True reference voltages.

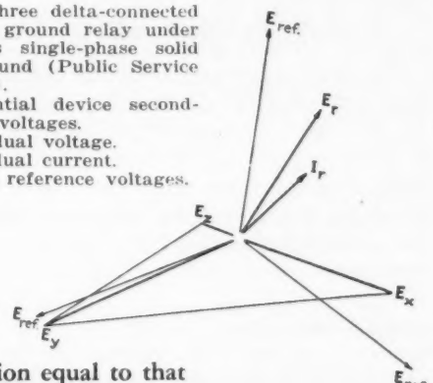
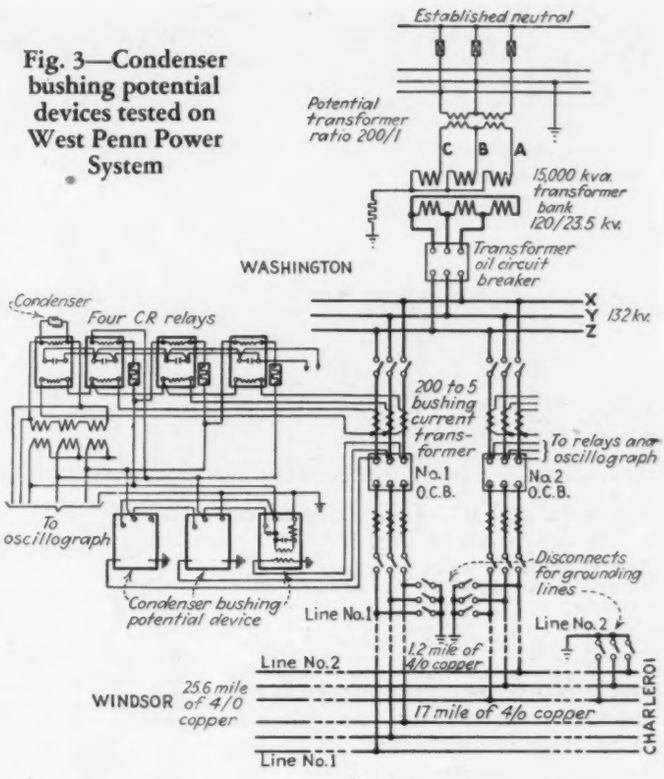


Fig. 2—Relay action equal to that with transformers

A series of tests was conducted at the Washington substation of the West Penn Power Company on April 6, 1930, to determine the performance of condenser bushing potential devices as installed, under conditions of line and ground faults. As indicated on the system diagram (Fig. 3) three devices are installed on the bus side of the 132-kv. line breakers and adjusted to furnish potential to type CR overcurrent directional phase and ground relays:

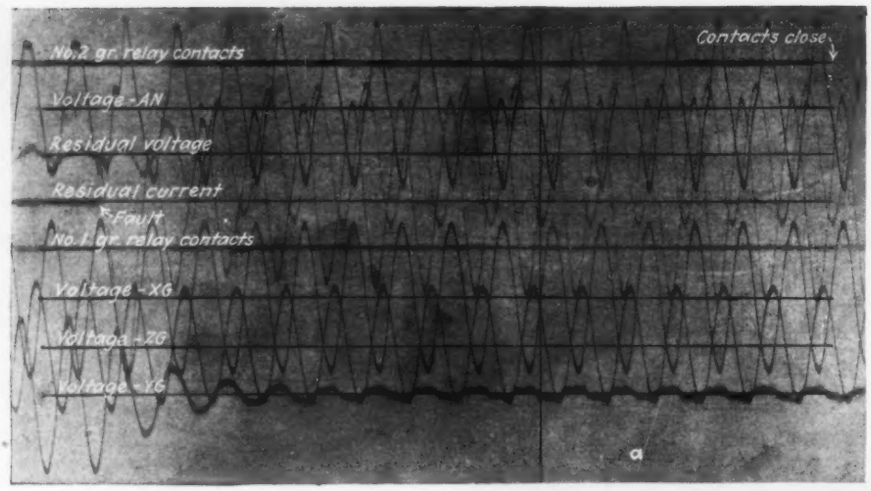
Fig. 3—Condenser bushing potential devices tested on West Penn Power System



The tests were conducted on the two 132-kv. parallel transmission lines between Windsor and Charleroi, connected as a loop through Washington substation and isolated from the remainder of the system at Windsor and Charleroi. The ground fault current was fed by the 36,000-kva. transformer bank at Windsor, which is energized on the low-tension side by the Windsor generators connected to limit the short-circuit current to approximately 500 amp. The high-tension neutral of the Windsor transformer bank was solidly grounded and served as the only ground source for the phase-to-ground faults. The fault was actually applied to the system by closing the line breakers at Washington.

A reference potential was obtained from one of the 15,000-kva. transformer banks and its associated 25-kv. potential transformers at Washington. The low-tension side of the power transformer was disconnected from the 25-kv. system. A set of three resistors were connected as shown to establish a neutral and the reference voltage thus obtained under normal conditions is not distorted. However, under fault conditions the reference voltage is distorted and the oscillograms indicate harmonics which are not present in the 132-kv. line. The bad wave form is attributed to the unloaded power transformer acting as a potential transformer and is not dependable as a reference for the severe faults.

The faults were correctly cleared, in every case, by line breaker operation at Washington. The relay operations were correct and the oscillograph records show exceptionally favorable voltage conditions across all relays. Oscillograms of a single-phase fault to ground (Fig. 4) show clearly the action of the potential devices and relays. A vector analysis (Fig. 5) of a distant ground fault (at Charleroi) indicates the actual voltage current relations of the system at the instant of relay contact operation. The main points of interest on this diagram are that the



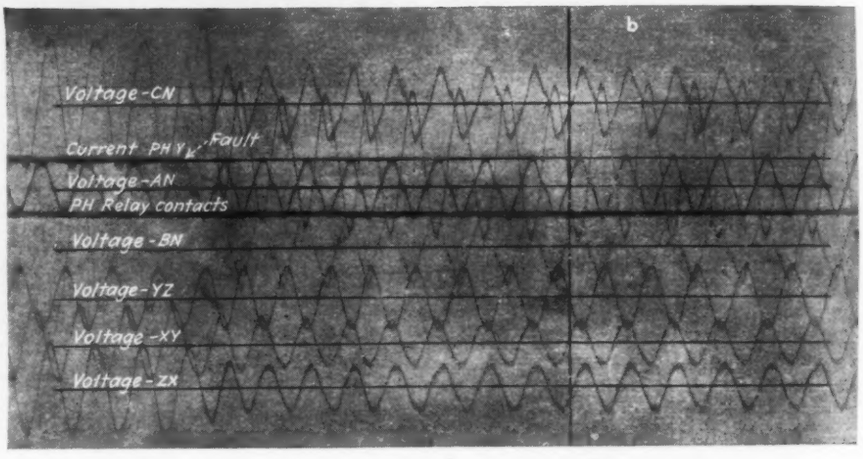


Fig. 4 (a and b)—Faults cleared on system of Fig. 3

Ground fault on phase Y. Note residual voltage and operation of ground relay contacts.

faulty phase-to-ground voltage is not entirely collapsed and the ground-relay angle is approximately 10 deg. less than the power-factor angle. The power factor of the fault is quite low as indicated by the 70 deg. lag of the fault current behind the faulty phase-to-ground voltage. The inherent characteristic of the potential device has reduced this angle, resulting in greater ground-relay torque. The 25-kv. bus potential reference voltage vectors have been superimposed on this diagram as a reference.

These tests have demonstrated that condenser bushing potential devices are entirely satisfactory for energizing phase and ground type CR relays.

Also proved for impedance relays

The first installation of impedance relays energized from condenser bushing potential devices was made on the Philadelphia Electric Company's 220-kv. system at Conowingo in April, 1928. The type CZ directional impedance relay is used to protect against line-to-line faults. Two line breakers and one bus tie breaker are each equipped with six potential devices. The burden of the instruments and relays requires the use of two potential devices per phase connected in parallel. The secondaries of the devices are connected star and wired through auxiliary switches operated by the circuit breaker, such that the star combinations are connected in parallel when the breaker is closed and separated when the breaker is open. This scheme makes it possible to synchronize across the breaker when it is in the open position and relaying with both sets of devices when the breaker is in the closed position.

A number of tests were made on the devices at this installation by isolating a generator and transformer bank to determine the performance under various operating conditions and investigations were made as to the effect of variations in secondary burden, power factor of burden, line frequency and voltage on the devices as adjusted for the normal relay burden. Generally these tests indicate that line voltage and frequency variation will not materially affect synchronizing or relay operation at this installation.

Due to large amounts of power transmitted over the high-tension lines and the very wide range of conditions of both generation and transmission on the Philadelphia Electric System the problem of relaying under all conditions is quite complicated. It is interesting to note that during the four years which this station has been operating there has been no faulty relay operation which could be attributed to incorrect performance of the bushing potential devices.

Simplify protection on Pennsylvania electrification

An interesting and effective application of condenser bushing potential devices for relay operation is made on the high-voltage, single-phase transmission system of the Pennsylvania Railroad Company in the vicinity of Philadelphia. The problem of ground fault protection of single-phase systems using a voltage balance relay is quite simplified in this installation by the use of potential devices:

Two 132-kv., 25-cycle, single-phase lines extend along the railroad right-of-way, receiving power through transformer banks at Lamokin. The midpoints of the high-voltage winding of the step-up transformers at Lamokin are grounded, insuring a voltage of 66 kv. to ground. The original installations utilize potential transformers in connection with type CV voltage relays to protect against ground faults. The later installation utilizes potential devices energized from condenser bushings on the high-voltage circuit breakers and power transformers for the purpose of obtaining the line-to-neutral voltage of each line. The secondaries of each pair of potential devices are connected to a Westinghouse type CDV relay (differential voltage balance).

With a ground fault the potential across the CDV relay coil energized from the potential device on the faulty line will be practically zero. The potential across the other coil of the CDV relay energized from the device on the unfaulted line approaches a value proportional to 132 kv. This unbalance in voltage tends to operate

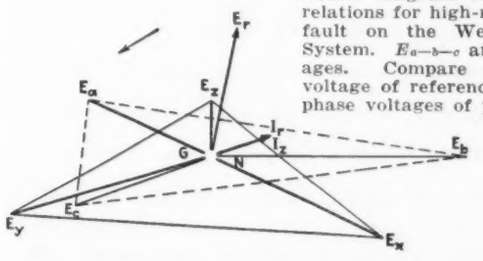
all type CDV relays connected to the faulty line. Selectivity is obtained, first, by segregating that portion of the line which has the ground fault and, second, by clearing the connections between the line and the trolleys. The relays which control the high-voltage breakers for segregating various parts of the system have a short time setting in order that they may trip these breakers. Then the remaining relays controlling the connections to the trolleys operate to isolate the fault completely. The system potential is symmetrical with respect to ground so that a fault on either line creates an unbalance and causes the relay to operate.

The potential devices on this application are normally operated at 55 volts so that the sum of the voltages across the relay is always 110 volts. Several field tests and approximately two years' service have demonstrated the success of this installation.

High-speed relay installation also successful

At the Chat Falls development of the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company several new and heretofore untried conditions of relaying presented themselves. In the first place power is being transmitted over a 200-mile line at 220 kv., 25 cycles, which is unusual, at least in the United States, in developments of this magnitude. In the second place condenser bushing potential devices are used for energizing Westinghouse type HZ relays for phase and ground protection on this line. In the third place some scheme was required for high-speed relay protection of a line fed from a ring bus. The line was connected to each part of the bus through two 230-kv. Deion grid breakers equipped with potential devices.

Switching operations on the ring bus will de-energize one set of potential devices. To prevent voltage failure



Vector diagram of voltage-current relations for high-resistance ground fault on the West Penn Power System. E_{a-b-c} are reference voltages. Compare phase-to-neutral voltage of reference with phase-to-phase voltages of potential device.

Fig. 5—Bushing device gives relay favorable voltages

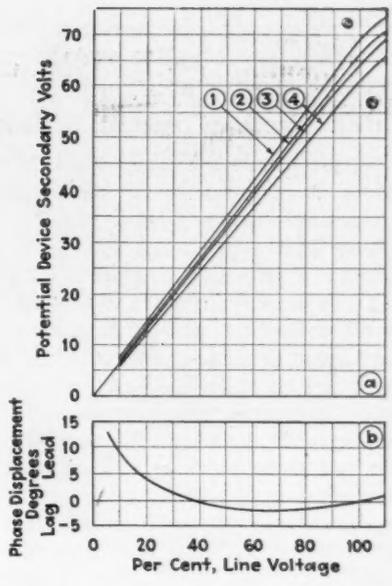
at the relays caused by feed-back of energized into de-energized devices an automatic throw-over scheme was required. A scheme using a combination of a transfer relay and type MX relay is utilized to select and permit only one set of devices to be connected to the relays at one time

"Hypernik" potential devices were selected for this application on account of their greater accuracy. The substitution of "Hypernik" for the usual silicon steel in this device reduces internal losses and thereby reduces the phase-angle error to about one-sixth of its original value at low line voltage and improves the ratio performance. One set of three devices is used to energize one set of type HZ phase relays, one set of type HZ ground relays and one set of type CV voltage relays. The reactive component of the relay burdens is sufficiently compensated with balance condensers, so that the over-all three-phase burden does not exceed 60 volt-amperes. The performance of the potential device was demonstrated on a 220-kv., 25-cycle circuit.

Fig. 6—More accurate than most potential transformers

(a) Voltage performance of a 230-kv., 25-cycle "Hypernik" condenser bushing potential device operating at a normal secondary voltage of 63.5. Each with burden power factor of 100 per cent.
1. 10 volt-ampere.
2. 15 volt-ampere.
3. 20 volt-ampere.
4. 25 volt-ampere.

(b) Phase-angle performance at 10-volt-ampere burden.



Curves obtained under various conditions of secondary burden and line voltage are illustrated in Fig. 6. It may be interesting to note here that the voltage error at 5 per cent of line voltage does not exceed one-tenth of one volt, which is more accurate than most potential transformers.

Short-circuit tests conducted on the Chat Falls-Leaside 220-kv. lines on December 13, 1931, thoroughly demonstrated the adequacy of the bushing potential devices. Various faults were placed on the system to check two requisites of the potential device combination: First, a high degree of accuracy was required under all fault conditions and, second, incorrect relay operation would not be caused by possible feed-back of a three-phase star combination of potential devices.

The accuracy of the devices was checked by clearing three-phase short circuits placed on the Leaside end of the line (200 miles distant). Generating capacity was such that minimum fault current conditions were obtained, resulting in about 5 per cent of normal voltage on the relays, which is the minimum upon which they are required to operate. The bushing potential devices were quite accurate down to 5 per cent of normal voltage and introduced practically no error in the relay settings.

No difficulty from feed-back

The question of feed-back involves conditions set up when a phase-to-ground-fault occurs. The distance setting of the ground relays would be affected if a voltage were built up across the secondary of the device on the faulty phase due to current taken by the phase relays from devices on the unfaulted phases. Phase-to-ground faults for several different system conditions indicated that the feed-back, if present at all, did not affect the ground or phase relay performance. A more severe test to determine possible effect of feed-back was made by disconnecting the 220-kv. line from one breaker bushing. The two other bushings were energized in the usual manner from the 220-kv., three-phase circuit and it was impossible to obtain any voltage reading whatever with a high-resistance voltmeter across the dead device. Thus no trouble due to feed-back was experienced.

This installation and test have shown conclusively that "Hypernik" bushing potential devices on a 220-kw., 25-cycle system can be relied upon to hold their ratio

accurately over wide variations in voltage and they are in every way equal to voltage transformers as far as relaying is concerned.

Capacitor potential devices an alternative

Installations and field tests of capacitor potential devices have been made which use the same potential device network as described above except that a stack or string of carrier-current coupling capacitors are used in places where the condenser bushing is not available. The capacitor units are arranged for suspension or pedestal mounting and connected phase to ground. The capacitor devices are rated at 100 volt-amperes for line voltages as low as 44 kv. and are more accurate than the "Hypernik" bushing potential device. Phase-angle errors over a range of 5 to 120 per cent of line voltage do not exceed 5 deg. These devices can be connected the same as high-voltage potential transformers and are applicable to the various schemes of high-tension relay protection without any secondary burden or circuit modification to correct for inherent errors.

▼

1.4 Kw.-Hr. per 100 Lb. to Cool Milk

On account of its economy and convenience the electric cooling of milk is rapidly increasing in the territory of the Greenfield (Mass.) Electric Light & Power Company. A six months' record of sixteen farms obtained in the last half of 1931 showed an average energy consumption of only 1.39 kw.-hr. per 100 lb. of milk refrigerated, the range of outputs being from 19,785 to 129,294 lb. during the period. Speaking before the recent Rural Electrification Institute at Amherst, Mass., F. L. Foss of the Greenfield company stated that the number of milk coolers installed on the system increased during the past year from 26 to 55 and he predicted that this year, despite the trying conditions prevailing in the Massachusetts milk market, there will be a sizable increase in the number of units installed.

Milk cooling is of vital interest to the dairy farmer. In order to market his product at the best possible price he must be sure not only that the milk comes from clean, healthy cows, but that it is kept pure and free from bacteria. A low bacteria count results from a proper system of milk cooling, as bacteria form slowly when the milk is kept at less than 50 deg. F. temperature and still better results are obtained below 45 deg. When taken from the cow milk has a temperature of from 90 to 95 deg., and it is generally accepted that there is no appreciable bacteria growth during the first two hours. This period is therefore available during which to cool milk to a point at which bacteria will not thrive.

In order to obtain data upon the electrical requirements of milk cooling on the Greenfield system check meters were installed on eighteen coolers selected at random and including the various leading makes of equipment in use in the territory with both home-made and commercial tanks.

Since the data shown in the accompanying table were compiled information has been secured for the months of December, January and February showing that it required 0.52 kw.-hr. to cool 100 lb. of milk during this winter period on eight farms which continued to use electric cooling in that season. These eight farms produced 609,887 lb. of milk between June 1, 1931, and March 1, 1932, with a total consumption of 6,776 kw.-hr., or an average of 1.1 kw.-hr. per 100 lb. of milk for the period of eight months. The differences in energy consumption on the various farms are to a large extent due to the variations in temperatures practiced. No attempt was made to compute fixed costs or to compare electric cooling with ice cooling, although the company has been assured by farmers operating electric coolers that ice cooling is far more expensive. The item of labor in ice handling is by no means inconsiderable. A representative dairy farmer recently stated that since the elimination of his icing problem he had been able to spend at least two hours per day on other work, and that in previous years his ice had cost him $75 per year apart from his own time, whereas with his electric cooler his entire cost for milk cooling will be under $50.

Average Cost of Operating Electric Milk Coolers

Covers Six Months Beginning with June, 1931

The coolers under test are all of the wet storage type and are of various makes. Twelve of the tanks are regular commercial jobs, while the balance (six in number) were constructed by the farmers themselves from specifications obtained, in some cases at least, from the manufacturers of the cooling units.

The tanks used on farms Nos. 2 and 3 are constructed with a concrete lining 2 in. thick, 3 in. of cork-board and 3 in. of concrete outside. The cover has 2 in. of cork-board covered top and bottom with ¾-in. pine sheathing. The tank on farm No. 4 is constructed with a lining made of Toncan sheet iron, 2 in. of cork-board, a layer of roofing paper and 1-in. boards on the outside. The cover has 2 in. of cork-board covered with ¾-in. boards. On farms Nos. 9 and 10 the tanks have a 3-in. concrete lining, 2 in. of cork-board, a 3-in. air space and 3 in. of concrete outside. The cover is made of 2-in. cork-board between 1-in. boards. The tank on farm No. 17 has a copper lining, 4 in. of cork-board and 3 in. of concrete outside. The cover is made of 2 in. of cork-board between 1-in. boards.

On all the farms except No. 6 the milk is put into cans while warm and then immediately placed in the cooler and left there until taken out for delivery. On farm No. 6 the milk is put into cans which are placed in cold running water for a period of from ten to fifteen minutes, after which the milk is put into the electric cooler at a temperature of about 80 deg. This particular cooler is equipped with a water agitator, which is operated approximately one hour night and morning.

All these farmers sell their milk wholesale, the milk being rated as "Grade A."

Farm No.	Kw.-Hr. Used for Milk Cooling	Pounds of Milk Produced	Kw.-Hr. Used to Cool 100 Lb. Milk	Six Months' Cost of Electric Milk Cooling	Milk Temperature After Cooling (Deg. F.) Night	Morning
1	547	40,733	1.34	$22.76	33	45
2	1,386	119,479	1.16	57.30	38	65
3	1,073	70,590	1.53	49.87	38	65
4	420	19,785	2.12	28.90	38	58
5	1,074	58,948	1.82	42.47	40	60
6*	840	60,092	1.39	29.53	34	44
7	447	33,145	1.34	21.74	40	48
8	1,568	120,935	1.29	58.30	40	65
9	704	36,675	1.91	29.76	40	60
10	1,023	67,756	1.51	40.64	40	60
11	1,559	129,294	1.2	56.64	34	40
12	352	32,199	1.09	17.71	48	48
13	497	32,016	1.55	35.59	38	58
14†	359	11,412	3.14	16.61	..	..
15	677	41,490	1.63	32.69	36	44
16	428	34,139	1.25	25.44	36	50
17	639	47,985	1.33	24.37	44	50
18	355	27,506	1.29	19.68	40	55
Average amount of milk per customer during period (lb.)						**57,056**
Average cost of milk cooling per customer during period						**$32.74**
Average kw.-hr. used to cool 100 lb. of milk during period						**1.39**
Average cost to cool 100 lb. of milk during period						**0.0573**

*This cooler operates four months only and is not included in the above summary.

†This cooler operates five months only and is not included in the above summary.

History Repeats Itself

By JOHN E. ZIMMERMANN*
President United Gas Improvement Company

DURING the lifetime of the United Gas Improvement Company there have occurred six business depressions, not counting that in which we find ourselves today. In all of these depressions pessimism was the prevailing attitude. Deep gloom surrounded business and industry. No ray of hope could be distinguished; no break in the depression could be seen. The future of the country and of industry was obscure; never again would business return to normal. In fact, in reading accounts of those hard times, one is struck with the similarity of the language used, and as a matter of fact, in most instances the accounts seem to describe exactly the situation as it exists today.

It is unnecessary to call your attention to the fact that better times followed each of these periods; that business and industry did improve; that the country did not go "to the dogs," and that our national wealth after each of these years of hard times was considerably increased,

So it is with the present depression. It is not my intention to dismiss lightly the tremendous difficulties which have faced us in business and industry, and as individuals, in the past 2½ years. But I would impress upon you that American business has weathered twenty depressions and that the road to recovery from our present economic upheaval is not to be found in the innumerable panaceas and suggestions now being offered nor in the hope that if sufficient laws are passed we can be legislated out of the depression.

I am a firm believer in America and its institutions. I know that this depression will pass away and that the country will have a return of good times, although I believe that our period of wild prosperity was not worth the bill which is now being paid in the form of great human suffering, destruction of morale, receiverships, bankruptcies, and what not. It is only by eternal watchfulness in the future that we can avoid repeating the excesses of the past.

During the last decade we have seen a tremendous growth in amalgamations and consolidations in all branches of business, sometimes built on sound economic principles and therefore of advantage to the people, but, unfortunately, sometimes actuated by the selfish desires of men to create empires regardless of the soundness of their economic principles.

It has, unfortunately, taken this depression to bring us to the realization that not sufficient constructive thinking was done during our periods of prosperity. One of its most shocking revelations is not the fortunes that have been lost or the misery and distress brought to millions of our people—which God knows is bad enough—but the evidences of corruption in government and business, accompanied by the sad spectacle of the loss of confidence in many of our leaders.

I believe that one of the contributory causes of the fear and distrust which is so prevalent today is this loss of confidence and the knowledge that too often decisions and actions have been entirely guided by sordid considerations and too seldom by those higher principles of honesty, decency and ethics to which no one should be a stranger.

The crying need of the hour is for honest and fearless leadership in high places, and I am also inclined to think that this leadership must come from within our business world and not entirely from Washington.

Excerpt from address at fiftieth anniversary of United Gas Improvement Company, Philadelphia, June 1, 1932.

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500 Watts Keep Shrub in Bloom Through Winter

Two incandescent lamps totaling 500 watts and a glass inclosure permitted a bougainvillea* to bloom through a Texas winter, reports Prof. John Beatty, Southern Methodist University, Dallas. He says:

"I had a bougainvillea growing in my yard last summer. Rather than let it be killed by the first frost, I constructed over it a small house about 4 ft. square and 8 ft. tall. The house had a large window on each side. Heat was supplied by two bulbs—one 200-watt and one 300-watt. Burning alone the 200-watt bulb furnished an inside temperature 15 deg. higher than the outside temperature. With both bulbs lighted an inside temperature was maintained 40 deg. higher than the outside temperature. The flower began to bloom in January and was gorgeous in February and March, a period in which there were no other flowers."

*Semi-tropical climbing shrub.

Flashing Lamps Without Moving Parts

By C. G. SUITS
Research Laboratory, General Electric Company

WHEN lights have to be flashed on and off at periodic intervals or when any control operation is performed that requires periodic pulsations of power it is no longer necessary to use contacts or any moving parts, vacuum or gaseous-tube control or bimetallic elements, and still the device can be operated from commercial alternating-current circuits of any voltage or frequency. Wide variations in voltage and frequency can now be tolerated without interruption of operation using the principle to be described. Furthermore, the interval between pulses can be adjusted over a wide range—from 1/30 second to 30 seconds. Flashing traffic beacons, railroad crossing signals, flashing signs and airport beacons represent just a few examples of such applications.

The accompanying illustration shows one application and the principal elements of its control. The principle can be extended to any number of lamps or devices depending on power pulsations for operation.

To understand the operation it is best to consider one of the simplest circuits of this type, shown in Fig. 1a.

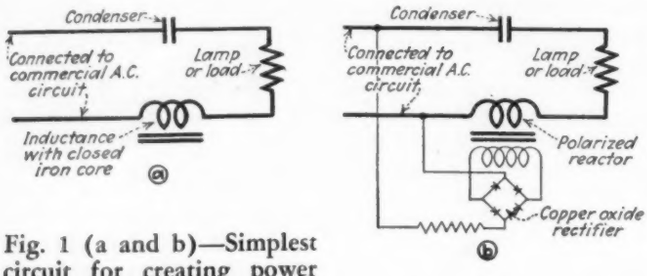
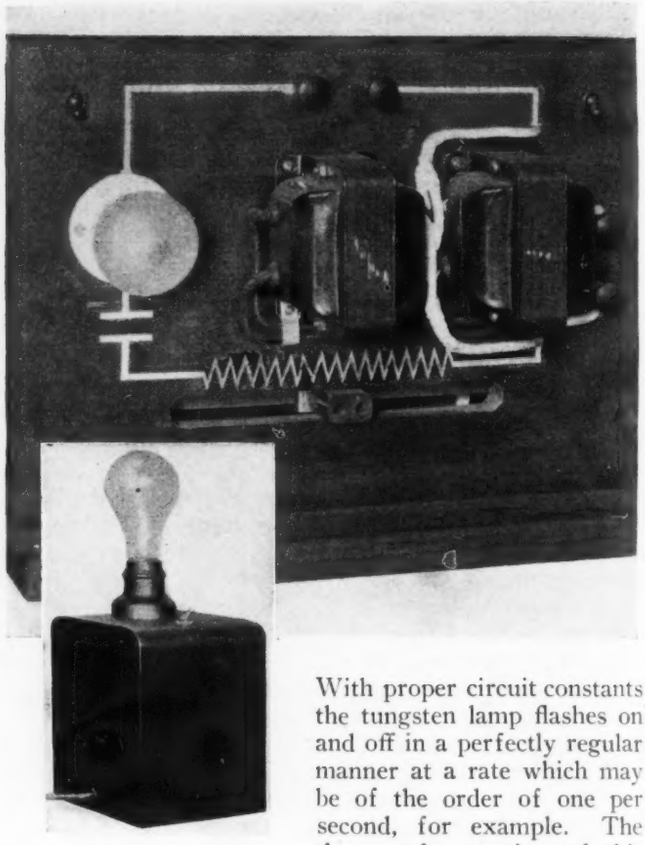


Fig. 1 (a and b)—Simplest circuit for creating power pulsations and modified circuit in which pulsation frequency can be controlled



With proper circuit constants the tungsten lamp flashes on and off in a perfectly regular manner at a rate which may be of the order of one per second, for example. The theory of operation of this circuit is well developed, but will not be considered in detail here. In general, it involves the dependence of the resonance condition of the non-linear circuit upon resistance and the change in resistance of the tungsten lamp with current. This particular pulsation circuit requires a relatively constant alternating voltage for proper operation.

This limiting feature is not present in the circuit of Fig. 1b, which is identical with the previous circuit with the exception of the reactor, which is polarized with a small amount of direct current from the copper-oxide rectifier. This circuit does not depend upon the resist-

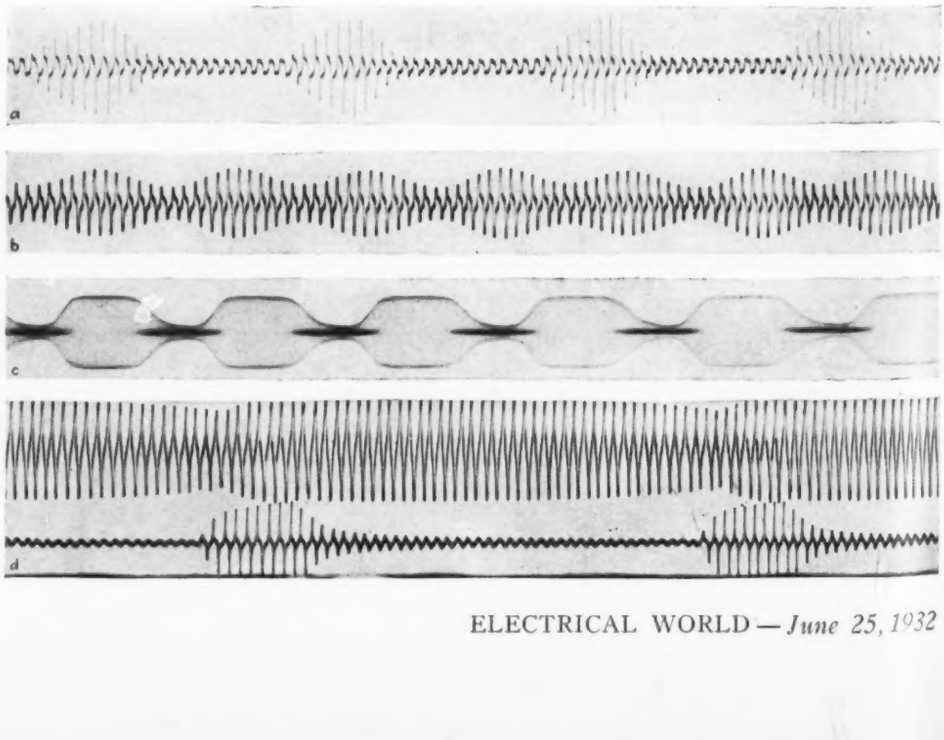


Fig. 2 (a, b, c, d)—Pulsation frequency can be controlled

(a) Lamp current for the life-test flasher described in text; (b) for flasher in which light intensity does not decrease to zero; (c) for circuit with duty cycle of one second on and one second off; (d) the lower trace is for flasher in which "off" period is relatively large.

ance characteristics of the tungsten lamp for its proper operation and may be made to function with a constant resistance load. The pulsation frequencies that are obtainable may be adjusted through wide limits by changing the direct current in the polarizing winding by means of a rheostat.

Some of the many types of current waveforms that may be produced in these circuits are shown in the oscillograms of Fig. 2, where the current has been recorded as a function of the time. One important property revealed by the oscillograms is the smooth and continuous manner in which the current rises and falls. From this fact one important advantage of this type of equipment follows—no radio interference is produced.

The great dependability of the phenomena, combined with the absence of moving members or fragile glass parts, are advantages of this type of control. I have had a circuit of the type Fig. 1b (oscillogram Fig. 2a) in continuous operation in my laboratory flashing a tungsten lamp 24 hours per day, five days a week, at the rate of approximately three per second since November 18, 1930. During this time the lamp has been flashed on and off approximately one hundred million times without any change in frequency that can be measured with a stop watch. For comparison purposes, a mechanical contactor mechanism of the type used for industrial control purposes is seldom rated at more than 1,000,000 operations. This life test circuit will tolerate line voltage variations of ± 30 per cent without substantial change in characteristics, except in so far as the life performance of the lamp is affected by overvoltage. The power supplied by the rectifier is of the order of 1 per cent of the power supplied to the lamp, so that it is practical to rate this unit so conservatively as to preclude the possibility of failure. Under these circumstances the life of a unit of this kind is indefinitely long except for occasional lamp burn-outs. Overall efficiency of the order of 80 per cent at 50 per cent power factor (average) may be obtained. Two circuits of the type of Fig. 1b may be so coupled as to produce an alternate flashing of two signal lamps.

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Pushing the Domestic Business

From various parts of the country come reports of vigorous campaigns to extend the use of electrical appliances in the home. The results are being reflected in actual returns showing materially larger energy consumption per customer.

For example, one large power company in the South has in four months sold more than $300,000 worth of appliances. In one district the average was $6 per customer, in another $5.06. Emphasis is apparently being put on refrigerators. The effect in the way of load building is worth attention, for while this company's average domestic consumption during the twelve months ended in April, 1931, was 716 kw.-hr., it rose to 794 during the following twelve months. In two districts the increase exceeded 100 kw.-hr. per customer. Another company, this one in the East, is making a drive for 1,000 ranges.

Meanwhile, after the first few dull months the spring movement of refrigerators has started and they are going out from the factories at the rate of 120,000 units per month. When it is realized that the estimated consumption of a domestic refrigerator is 600 kw.-hr. annually, and of a range 2,000 kw.-hr., the effect of these devices in building up the load can be appreciated. The annual energy sales for domestic customers are close to 12,000,000,000 kw.-hr. A million ranges has been set as the objective for this year's sales. This will mean an increase of 2,000,000,000 kw.-hr., or 16 per cent of the present consumption, for this one device alone.

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Eye Specialists Turn to Lighting

Seeing is necessarily a partnership between lighting and the visual sense, but for years neither lighting specialists nor eye specialists have been conscious of their mutual interest. However, lighting is now becoming recognized by ophthalmologists, oculists and optometrists as an important and effective aid in correcting and in conserving vision. It behooves the lighting specialists also to learn something of the language and the problems of eye specialists.

An example will illustrate this mutual interest very well: A leading oculist has about twenty-five patients among the employees of a prominent banking institution. The bank and its offices are in a very modern building in which the lighting should be better than average. The oculist exhausted all his facilities for eye correction without stopping the progress of certain eye ailments. For example, certain cases of progressive myopia persisted. He turned his attention to his patients' conditions of work and studied the lighting not only with his eyes but with a foot-candle-meter.

Important executives as well as typists and clerks were found to be working under intensities of illumination of the order of one foot-candle. These were checked by an authentic photometer. Offices done expensively in period style contained "candle" fixtures with 25-watt flame-shaped lamps without shades. Twelve 25-watt bare lamps in an office 18 feet by 36 feet! Including the daylight, this executive had about four foot-candles on his desk, approximately one foot-candle being contributed by the artificial light.

Areas occupied by other employees contained no windows and the general lighting was commonly one or two foot-candles. A hundred employees on one floor were working under these harsh and dingy conditions. In a few cases they obtained more light by means of a portable lamp. From these open offices these employees looked down upon the public room richly finished with polished marble and furnished with beautiful equipment. Indeed, here the primitive in lighting was blended with modern richness of architecture and furnishing.

The blame must first go to the architects, but lighting interests serving this institution must share the responsibility for contributing to the inefficiency of employees and, worse still, to the destruction of eyesight. Lighting interests should be ashamed of such a lack of lighting consciousness on the part of the officials and employees of this modern institution housed in a costly modern building. And they should be ashamed also of such proofs of their own neglect or lack of salesmanship. Maybe the eye specialist will also be the lighting specialist of the future. Certainly in this case he was the one who awakened the authorities to a serious situation. Needless

to state, the way readily opened for vastly improved lighting. That such conditions are to be found on every hand is readily proved by opening the eyes to them. Times are never too hard to eliminate primitive lighting. With the increasing interest of reputable eye specialists, lighting specialists are acquiring formidable allies.

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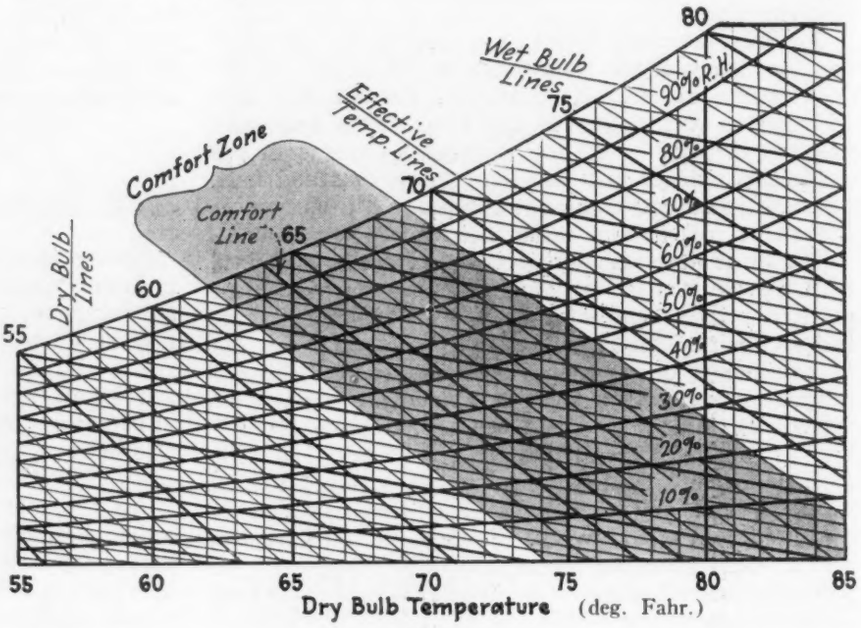
Comfort Chart for Air Conditioning



Study, become familiar with and apply the "comfort chart," was the urgent advice of Dean F. Paul Anderson, University of Kentucky, to the engineers and salesmen in attendance at the recent conference on air conditioning at the Case School of Applied Science in Cleveland. This advice is so pertinent and worth while that it and the chart are reproduced in ELECTRICAL WORLD for the benefit of the many now interested in the sale and use of air conditioning. Explaining the chart Dean Anderson said:

"For years and years we have all measured temperatures with a Fahrenheit thermometer. But this does not represent temperature as far as humankind is concerned. The temperature of a room is measured by another temperature which is unseen; it is the temperature that records our sensitiveness to heat and cold, and it has been called the effective temperature. It has been known for a great many years that there did exist something that was conducive to a comfortable feeling in any atmosphere. At the laboratory of the American Society of Heating and Ventilating Engineers in Pittsburgh there was undertaken a number of years ago a study research for the purpose of determining whether there was a law that was followed absolutely, showing the relationship of temperature, humidity and man's sensitive appreciation of heat and cold, or, in other words, was there a law that measured the comfortableness of man. What was it that made one feel on a spring morning different from the way one did on a cold, dreary October morning?

"It was found that there is a relationship between dry bulb temperature, wet bulb temperature and air motion which is just as invariable as the law of gravitation. Willis N. Carrier a number of years ago developed what he designated the psychrometric chart. The psychrometric chart was the first expression of a law of relationship between humidity and temperature, and this psychrometric chart stands like the Rock of Gibraltar. This effective temperature principle has been placed on top of the psychrometric chart. The effective temperature lines take an angle on the psychrometric chart as shown on the comfort chart. This particular chart gives you the psychrometric chart within the range that man lives, and it also prescribes what we think is, within reasonable limits, the comfort zone.

"The dry bulb temperatures, the relative humidities, the effective temperature lines and the wet bulb temperatures are indicated on the chart. Any combination within the comfort zone of dry bulb temperature and wet bulb temperature falling on any line of effective temperature gives in each case the same sensitive heat reactions to the human being. In other words, the atmospheric envelope has the same effective temperature in every one of these various combinations.

"For instance, we have on the effective temperature line of 66 deg. a dry bulb temperature of 80 deg., a wet bulb temperature of 50 deg., which means a relative humidity of about 5 per cent; now suppose we follow the 66 deg. effective temperature line until we reach a relative humidity of 90 per cent, a dry bulb temperature of 67 deg. and a wet bulb temperature of 65 deg. In other words, we can reduce our room temperature in winter from 80 deg. to 67 deg. and have the same feeling of comfort by merely increasing the humidity.

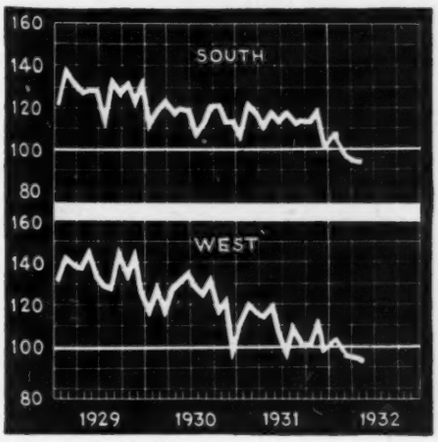
"The comfort condition of atmosphere in summer is the one that is uppermost in our desires just now. This involves two things—reducing the temperature of the air and taking out some of the humidity. The cooling unit is a much-talked-of development just now.

"Look at the comfort chart again: We have a dry bulb temperature of 84 deg., a relative humidity of about 78 per cent, which corresponds to a wet bulb temperature of about 80 deg.; the effective temperature is 78 deg., or far outside the comfort zone. Now suppose we reduce the relative humidity from 78 per cent to 10 per cent, leaving the dry bulb temperature the same; we would then have an effective temperature of about 69 deg., which corresponds to a wet bulb temperature of about 55 deg. and is in the zone of comfort.

"The practical thing to do in this case would be to reduce the dry bulb temperature from say 84 deg. to 75 deg. and reduce the wet bulb to 64 deg., which would bring the relative humidity down from 78 per cent to about 56 per cent and we would be on this same effective temperature line of 69 deg. in the comfort zone."

Southern Industry Holds; West Falls Slightly

Late in 1931 industrial activity in the South, after holding its level for nearly two years, fell off rapidly and in the course of a few months lost about 20 per cent. Reports of energy consumption in various kinds of manufacturing plants received by the ELECTRICAL WORLD indicate that this downward movement has ceased. The average of industrial activity in May was, in fact, a trifle higher than in April, although it remains 21 per cent lower than it was at this time last year. The food products group alone is higher than in May, 1931, and by a larger margin—12 per cent—than in April. Textiles continue to decline; so does the iron and steel industry, but metal-working gained 8 per cent over April, though still very low. In the West there was no such abrupt change. The downward movement was more prolonged but less rapid. It has not yet ended, although the changes are quite small. The average index for May was 2.7 per cent down from April. Further losses in the metal and forest products industries and a relapse of the stone, clay and glass group to the March level were not wholly compensated by gains in chemicals, foods and rubber.



Indices of Industrial Activity in South and West

Base: Average Month, 1923-1925 = 100

Industrial Groups	South May, 1932	South April, 1932	South Mar., 1932	South Feb., 1932	South May, 1931	West May, 1932	West April, 1932	West Mar., 1932	West Feb., 1932	West May 1931
All industry	**93.6**	**92.9***	**95.2**	**104.1**	**118.2**	**94.0**	**96.2**	**97.0**	**103.7**	**119.1**
Chemicals	130.2	117.0*	127.4	134.9	144.8	89.5	82.7*	81.1	91.6	90.2
Food	177.0	148.0	135.0	151.0	158.1	115.5	114.8*	116.8	127.0	144.8
Iron and steel	66.8	76.0	82.1	117.6	175.5	.....	.....	.....	.....	.....
Metal working plants	64.7	59.8	60.6	68.8	95.6	.....	.....	.....	.....	.....
Metals group	66.0	69.0	72.6	96.0	140.7	36.8	38.0*	42.1	49.7	69.7
Forest products	38.2	44.5	48.4	60.8	71.0	117.0	128.0	130.0	135.2	154.1
Paper and pulp	128.3	134.1*	148.0	140.5	167.4	131.2	123.1	132.3	121.4	143.3
Rubber	85.0	64.3	71.5	93.0	105.3	100.8	99.0	102.5	98.1	166.0
Shipbuilding	.....	.....	.....	.....	.....	101.7	100.7	86.4	87.4	74.5
Stone, clay and glass	126.4	148.9*	126.1	94.7	140.2	80.2	96.6*	78.0	80.8	80.2
Textiles	76.2	85.6	96.2	107.0	102.4	.....	.....	.....	.....	.....

*Revision

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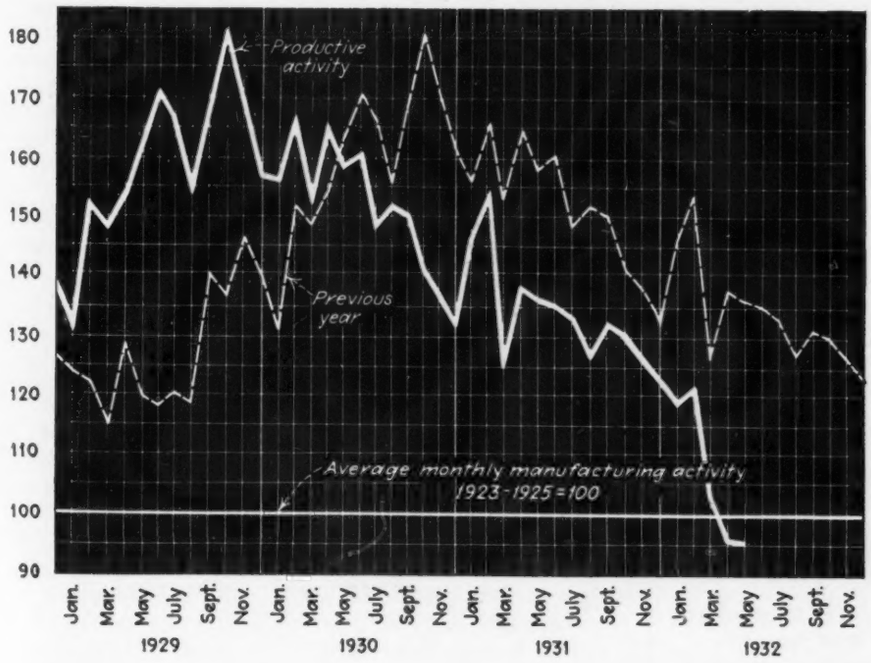
Electrical Manufacturing Leveling Off?



Electrical manufacturing plants were, in the average, about as active in May as they had been during April. That is, after a period of decline lasting 2½ years with an occasional brief interruption, lately accelerated, and severe enough to have cut the rate of operations in half, we now have a month that shows no further curtailment. Compared with other industries the magnitude of the decline is not abnormal. Electrical manufacturing is closely related to the machinery and metal-working industry, but its decline has been much less severe than that of this latter group. The present rate of electrical manufacturing activity is 53 per cent of the maximum in 1929; the present rate for the whole metal-working industry is 37 per cent of the maximum. Further, during the past few months the operations of quite a number of the reporting plants have been holding up fairly well. Some are doing better than in the early winter, though the general average at that time was 30 per cent higher.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base: Average Month, 1923-1925

Month	1929	1930	1931	1932
January	131.3	156.2	146.6	120.0
February	151.8	165.2	154.3	122.2
March	148.3	153.0	126.1	102.9
April	154.6	164.9	138.1	95.6
May	163.5	158.0	136.7	95.3
June	170.5	160.2	135.2	.....
July	166.6	148.5	133.4	.....
August	155.4	152.2	126.9	.....
September	168.8	150.0	132.6	.....
October	180.6	140.6	130.4	.....
November	169.5	137.5	126.9	.....
December	157.0	132.4	123.5	.....

Broadly, it appears that production directly for the consumer market is going on at a steady pace and in no inconsiderable volume, while heavy manufacturing, for the central-station and industrial market, continues to reflect the lack of demand for additional facilities.

READERS' FORUM

Uniform Rates Should Be Made

To the Editor of the ELECTRICAL WORLD:

I have just concluded reading the very interesting article by Paul M. Downing, vice-president, N.E.L.A., in the June 11, 1932, issue of ELECTRICAL WORLD, entitled "Rate Simplification Needed." To one who has devoted years to encouraging rate simplification in the industry, the title of this article was exceedingly enticing and it was read with avidity. However, after so much illumination upon the existing conditions, to be confronted with the concluding statements, among which is found "The writer has no panacea to suggest," was disheartening. If one has given so much thought to the subject and apparently so much investigation to existing rates, it offers little hope to those interested in accomplishing that which is suggested to find at the end a substantial dismal abyss, or perhaps a Delphian labyrinth, if I may be permitted to follow the author in some of his digressions.

It strikes me that to continue the motheaten analogies so frequently attributed to the housewife is not only not helping in the solution of the problem but, rather, is adding fuel to the flame. Is it to be argued that because we have archaic methods of doing business with certain things that we shall continue those archaic methods with every new system of living which is evolved in the future? This seems to be a fallacious premise upon the very face of things. The reference to the ordering of a dozen cans of "Carnation" seems beside the point, for it is probably true that the particular housewife has not the slightest idea of the quantity of cream contained within the can which she ordered. How many housewives know the quantity of the commodity which they purchase by can which is actually contained in the can? To be sure, by law we have attempted to eliminate deception by requiring that the quantity which the can or package contains shall be displayed upon the outside. But even with this, how many housewives know how many ounces there are in a pint? Again, how many radishes or carrots are there in a bunch? How much egg is there in a dozen eggs?

I do not believe that the electrical industry is open to so much criticism as this article would imply. On the other hand, I feel that the electrical industry should be commended for sticking to its guns and not being swayed by those who know better, but are continually harping on the strings of the uninitiated instead of endeavoring to point out to those unfortunates that they can learn what a kilowatt-hour is just as readily as they know what a quart is, with this exception, that they cannot see the kilowatt-hour as they can see the quart. The industry must find some way of definitely translating the intangible article which it sells into something tangible; that is, of educating its customers to appreciate that which they are paying for in the form of the work done by that commodity. This is not impossible.

It is distinctly true that there have been many devices employed which are the products of the fertile brains of rate experts, and which sometimes lead the customer to a state of "confusion worse confounded." But why accept this situation as a necessity? As Mr. Downing says very cogently, that which is needed is co-operation, and it should be voluntary co-operation, not that brought about by a drastic order from some regulatory body, of which there may be some 49 possible forms ere long. It lies within the power of the industry to co-ordinate this situation. It lies equally within the power of the industry to abolish a multitude of exceptions, riders, discounts, etc., and get right down to brass tacks, giving readily understandable rates expressed in the terms which are properly and desirably applicable to the particular industry.

There should be no attempt to eliminate the element of demand. It is fundamental that each customer ought to pay his fair share of the cost of that which he purchases. Unfortunately it has been the policy of our civilization to look askance at what is almost axiomatic and try to refrain from doing the right and proper thing. Is there any good reason why the electrical industry, which has endeavored to start out upon the right premise and make its charges proportionate to the service rendered, should now about face and return to the dark ages which prevail all about us, and which, in fact, may have much to do with the present economic situation in which we find ourselves? It is not time to do such a thing. It is a time, however, when the members of the industry should stand up and be counted. It is a time when they should co-ordinate so as to bring about the impossibility of a person who may reside in the East moving to the West and finding himself confronted with a price for an identical commodity which he purchased in the East which is founded upon an entirely different form of expression. Just so long as no concerted effort is made to eliminate this situation by those responsible for the industry, just so long will this or a worse condition exist, for past experience has taught me that if we ever reach a situation where the rate forms are the results of the evolutions of the brains of regulatory bodies, we will have a situation which will be infinitely worse than that which now confronts us. Industry, it is up to you.

CHARLES R. VANNEMAN,
Consulting Engineer.

Albany, N. Y.

Popular Demand for Electric Appliances

So great is the popular demand for certain types of appliances that at the present time their sales stand out as the best of almost any product. In 1931 it is estimated that 900,000 electric refrigerators worth $216,000,000 were sold, also 30,000 household floor machines at $1,680,000, 686,648 vacuum cleaners at $34,332,400, 707,303 electric fans at $10,170,532, and 72,000 electric cookers at $489,000. Certain of these appliances right now are exceeding their tremendous sales of a year ago. Such a demonstration must convince even the most hidebound sceptic of the merchandising opportunities that the proper handling of household electrical appliances presents.

P. A. O'CONNELL,
President National Retail Dry Goods Association.

Men of the Industry

O. B. Reemelin Vice-President of Dayton Utility

O. B. Reemelin, formerly manager of the electrical division of the Dayton Power & Light Company, has been appointed vice-president in charge of electric operations and a director of that

company. A graduate of the University of Cincinnati, College of Engineering, Mr. Reemelin went to Dayton, Ohio, a short time after his graduation and was appointed in September, 1905, as engineer in the underground construction department of the Dayton utility. Three years later he was named chief inspector. In 1913 he was made superintendent of the company and in 1915 general superintendent. In the year 1925 Mr. Reemelin was made manager of the electrical division.

▼

HENRY C. CUMMINS, a vice-president of the Standard Gas & Electric Company, has been elected a member of the executive committee to succeed the late Halford Erickson.

•

HAROLD J. WAPLES has been elected chairman of the Public Utilities Commission of the State of Michigan, succeeding Robert H. Dunn, who continues as a member of the commission.

•

W. B. HOPKINS has resigned as vice-president and engineering manager and as a director of the Stone & Webster Engineering Corporation, New York, effective June 30. Mr. Hopkins' future plans have not yet been announced.

•

HENRY I. HARRIMAN, chairman of the New England Power Association, has been elected president of the National Chamber of Commerce for the ensuing year to succeed Silas H. Strawn of Chicago. The office of chairman of the board was left vacant with the retirement of Julius H. Barnes.

•

GERARD SWOPE, president of the General Electric Company, received the degree of doctor of science at the recent commencement exercises of Washington University, St. Louis. Mr. Swope is a native of St. Louis.

•

G. W. MILLIKEN, district manager of the Southern Colorado Power Company at La Junta, has been made vice-president in charge of sales to succeed E. F. Stone, who is resigning because of ill health.

•

RUSSELL H. BALLARD, president of the Southern California Edison Company, Ltd., was made the recipient of the honorary degree of doctor of business administration by the University of Southern California.

▼

J. E. Harsh Heads Middle West Division

James E. Harsh, vice-president and general manager of the Empire District Electric Company of Joplin, Mo., was elected president of the Middle West Division of the National Electric Light Association at the convention held recently in Kansas City, Mo. Mr. Harsh entered the public utility field in 1903 as a meter reader with the Denver Gas

& Electric Company. He joined the Empire District Electric Company in 1909 and served as new-business manager until 1912; he was then transferred to Sedalia, Missouri, as new-business manager of the City Light & Traction Company. From there he went to Salina, Kan., as general manager of the Light, Power & Gas Company. His next move was to Lincoln, Neb., as general manager of the Lincoln Gas & Electric Company. He was transferred to Charleston, W. Va., as general manager of the Virginia Power Company, which position he held until transferred to Joplin as general manager of the Empire company.

▼

OBITUARY

R. J. WILDER, manager of the Central Massachusetts Electric Company, with headquarters at Palmer, Mass., died recently in that city after a protracted illness. Mr. Wilder was formerly power sales engineer of the company and was active in the New England division of the National Electric Light Association.

•

JEAN-ANTOINE ARRIGHI DE CASONOVA, chief engineer of the Union de l'Electricité, Paris, died recently in that city at the age of 53. Joining this organization in 1920, he directed the extensions of the huge power station at Gennevilliers, and subsequently the reconstruction of the Vitry-Nord station, and finally, the recently completed power station hitherto known as Vitry-Sud, but in future to be known as the Arrighi station.

•

DR. ADOLF KREBS, consulting engineer, died suddenly at his home in Jamaica Plain, Boston, Mass., June 15. Dr. Krebs was born 67 years ago in Wiesbaden, Germany, and obtained degrees from the University of Berlin and the Charlottenburg Polytechnic Institute. He had been connected with the German General Electric Company and with Siemens & Halske in important engineering and administrative positions, having been secretary to Wilhelm von Siemens and for years his chief engineering and financial representative in South American, in connection with important electric developments. Dr. Krebs was a member of various technical associations.

•

GILBERT E. RYDER, vice-president of the Superheater Company, New York and Chicago, died May 17 at his home in Larchmont, N. Y., from a sudden heart attack. In 1911 Mr. Ryder joined the Superheater Company as a service engineer, and he was elected vice-president in charge of sales and service in 1921. For many years he participated actively in the affairs of several railway associations. He was born in Minneapolis, Minn., and studied engineering at the University of Wisconsin and the University of Illinois. After extensive railroad experience he became associated with the United States Geological Survey and subsequently joined the staff of the *Railway Review* as associate editor before he affiliated himself with the Superheater Company.

New Equipment Available

Master Switch to Regulate Control Circuits

A new master switch, known as type NX, the function of which is to regulate the control circuits of a magnetic controller, is announced by the Electric Controller & Manufacturing Company, Cleveland, Ohio. It is designed for use where a maximum of three points of speed control in either direction is required.

Some of the outstanding features of this switch are: Ball bearings of the combined radial and thrust type, quickly renewable contact segments, contact fingers equipped with tips made of long-wearing alloy material, dead blocks which fill the intervening spaces between contacts, etc.

▼

Improved Guy Wire Clip

A new guy wire clip that can be installed in a few seconds without serving, wrapping or the use of special tools has been announced by the W. N. Matthews Corporation, St. Louis, Mo. A unique feature of the clip is the tongue in the center. This tongue acts as a wedge between the two strands and prevents the clip from slipping in either direction. The clip is quickly and easily installed by simply placing it over the two wires so the special non-slip tongue fits between the "strands," then drawing the flanged sides together with an ordinary pair of pliers. The clips are available in aluminum, galvanized iron or copper and are furnished in five sizes for ¼-in. to ½-in. strand.

▼

A HIGH QUALITY SLOT INSULATION which is a combination of varnished cambric and fish paper, making the material of high dielectric and tearing strength and great flexibility, known as "Irv-O-Slot," is announced by the Irvington Varnish & Insulator Company, Irvington, N. J. More stable flexibility is accounted for by the varnish film on both sides of the fish paper sealing in the proper amount of moisture, it is claimed.

•

A LINE OF CAPACITOR MOTORS known as type RZH, which are condenser-start, condenser-run, split-phase motors, the condenser capacity varied from start to run by means of a switch and an auto-transformer, is announced by the Wagner Electric Corporation, St. Louis, Mo. The conduit box is an integral part of the condenser box, effecting a neat arrangement, with no separate terminal box on the motor frame. Removable front gives easy access to lead connection. They are available as rigid-mounted or rubber-mounted motors, drip-proof or totally inclosed.

▼

Power-Operated Telescoping Pole Derrick

A power-operated telescoping derrick that sets short poles or works under low heads at a minimum height of 16 ft. or raises, by motor power, to any height up to 22 ft. above the ground for handling long poles is a recent improvement announced for the "Highway,"

model "HC" earth-boring machine. The new derrick is built into the boring unit as an integral part. It consists of two sections of seamless heat-treated steel tubing, the upper one of which telescopes into the lower under the control of the motor.

Power is taken through the boring head and applied to the upper section through a worm-and-rack arrangement. Control is by means of a lever mounted on the lower tube support within convenient reach of the operator. When at minimum height the boring machine leveling device permits the derrick to rest horizontally on the truck platform out of the way for traveling or storing. When the truck is backed into working position a slight movement of the power-leveling control brings the derrick into vertical position in a few seconds' time. Another movement of the derrick control lever raises the derrick to the required height quickly and easily.

▼

Split-Second Supervisory Control With Two Wires

Designed, not to supersede existing systems but to be applied where extremely high speed is desirable, a new type of supervisory control which eliminates the time delay of previous selective systems by direct selection of the desired equipment instead of by the step-by-step method is being offered under the name of "Polaricode" by the Westinghouse Electric & Manufacturing Company. With only two wires any one of 25 units can be selected in less than 0.8 second.

"Polaricode" operates by the use of single electrical impulses, directly selecting the desired one of a distant group of relays. Polarized selection is obtained by the use of "Rectox" valves with standard telephone type relays. The "Rectox" valve is a dry type rectifier with no moving parts and is a time-proved unit in service of this character, it is said. Maintenance is not required and it has a long life.

Distinctive features of "Polaricode" control are claimed as: High speed, reliability, simplicity, safety, line-wire economy, parallel station operation, anti-pumping control, remote metering and synchronizing, raise-lower control and all-relay, steel-panel, dustproof construction.

▼

AN ELECTRIC AMMONIA DISSOCIATOR which yields a dry gas containing 75 per cent hydrogen and 25 per cent nitrogen is announced by the Ajax Electric Company, Inc., Philadelphia, Pa. Due to the purity of the raw material, anhydrous ammonia, the gas produced is not contaminated with any hydrocarbons, oxygen, oil or sulphur. A standard cylinder of 100 lb. ammonia will yield 4,500 cu.ft. of dissociated gas. These dissociators come in the following standard sizes: 50, 150, 300 and 500 cu.ft. per hour capacity.

•

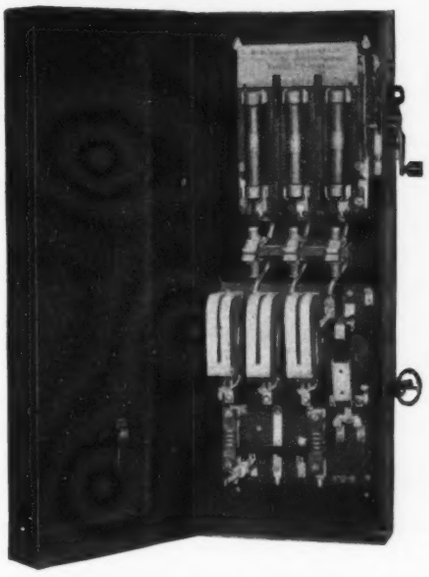
A WATT-HOUR DEMAND REGISTER, type DR, which combines the regular watt-hour meter register with the scale and pointers of an indicating block-interval demand meter is announced by the Westinghouse Electric & Manufacturing Company. By replacing the register and cover of a standard single-phase or polyphase OB watt-hour meter with this new register and special cover the type OB meter is converted into an indicating, block-interval, demand meter. After this change has been made the meter will indicate the maximum demand and integrated kilowatt-hours.

Reduce installation cost . . .

Save space . . .

Improve appearance . . .

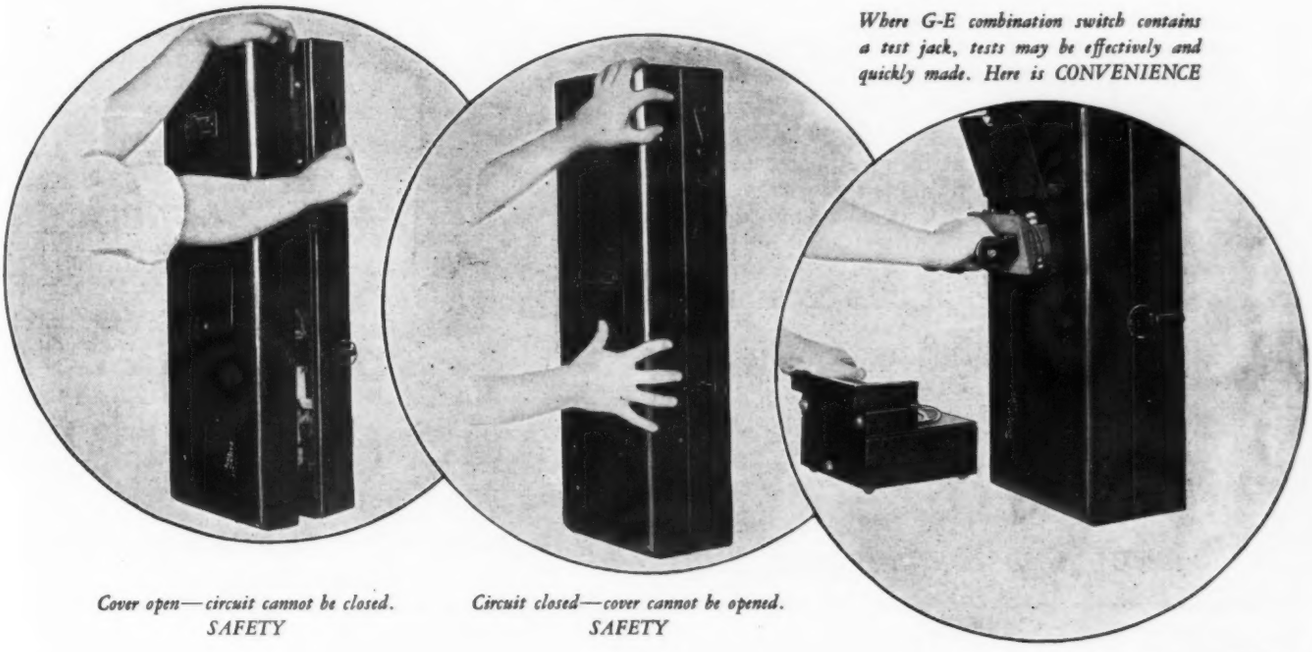
with G-E Combination Magnetic Switches



UTILIZE a General Electric combination magnetic switch and you reduce installation cost. The cost of installing a combination magnetic switch is much lower than for an installation of individual devices. Because General Electric combination magnetic switches are of extremely compact design and occupy much less wall space than that required for mounting separate devices, you also save space. And because a much neater and more attractive mounting can be made, you improve appearance. These advantages are worth considering.

Avail yourself of complete information about G-E combination magnetic switches. Two descriptive publications, GEA-1587, and GES-791, are at your disposal, and will be sent upon request to your nearest G-E office, or, if more convenient, address General Electric Company, Industrial Department, Schenectady, New York.

INCREASE SAFETY AND CONVENIENCE . . .



Where G-E combination switch contains a test jack, tests may be effectively and quickly made. Here is CONVENIENCE

Cover open—circuit cannot be closed.
SAFETY

Circuit closed—cover cannot be opened.
SAFETY

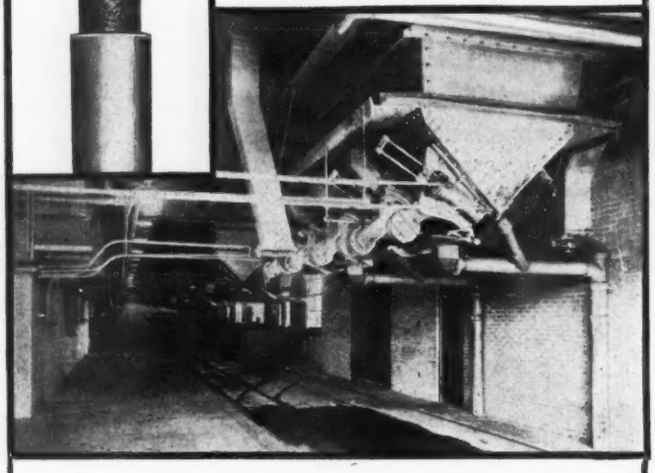
301-105

GENERAL ELECTRIC

THIS WIRE MAKES

PERMANENT CIRCUITS

IN PLACES LIKE THIS



An ashpit is probably as tough a place as there is for wiring to resist failure.

Fumes, heat, steam and moisture filled ducts attack light and power wiring and frequent failure not only takes place—but is expected!

Yet continuous outage and maintenance is not necessary at all. It can be easily overcome by the proper selection of wire built to operate without failure under these severe conditions.

The ROCKBESTOS WIRE illustrated will meet every condition from complete submersion to 250°F., without failure—and indefinitely.

This wire is insulated with permanent asbestos, applied and impregnated by the ROCKBESTOS PROCESS. It is topped with a lead sheath, making a universal wire to operate anywhere under the most severe conditions.

It's made in sizes up to 2,000,000 C.M. and for voltages up to 7,500.

Let us send you a sample of this Type EL wire and show you further how failureproof it is. Address, ROCKBESTOS PRODUCTS CORPORATION, 297 Nicoll Street, New Haven, Connecticut.

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—the wire with permanent insulation

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Without obligation, send me a sample of your Type EL failureproof wire.

Name ..... *Title* .....

Company .....

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39 *years' service*

has proved the superiority of

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The Fibre Conduit Co.

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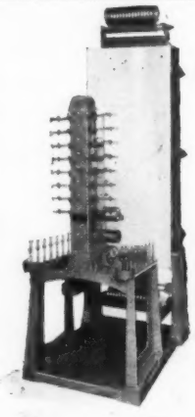

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Great Mechanical Strength

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Chattanooga, Tenn.

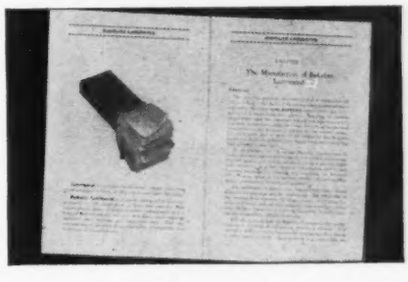
Bakelite Laminated—*the material that serves a dual purpose in Refrigeration....*

Water Cooler made by Westinghouse Electric & Mfg. Co., E. Pittsburg, Pa.

DESIGNERS of mechanical refrigeration equipment long have recognized the advantages of Bakelite Laminated for electrical insulation —its dielectric strength, resistance to extremes of heat and cold, and to acids, oils and moisture. It is only recently that they have come to realize the beauty and value of Bakelite Laminated for exterior finish of cabinets.

The advantages of Bakelite Laminated for refrigerator cabinets is splendidly demonstrated by the Westinghouse water cooler. Here the permanently rich sheen of deep black Bakelite Laminated, serves as an effective foil for the bright chromium inlays, corner trim, and fittings.

Designers and manufacturers of electrical appliances are invited to consider the versatile character of Bakelite Laminated, and its adaptability to decorative as well as utility purposes. Our engineers will be glad to cooperate with you in adapting Bakelite Materials to your special needs. You may find much of interest in our Booklet 3L, "Bakelite Laminated", which further describes this material, its properties and uses. Why not write for a copy?



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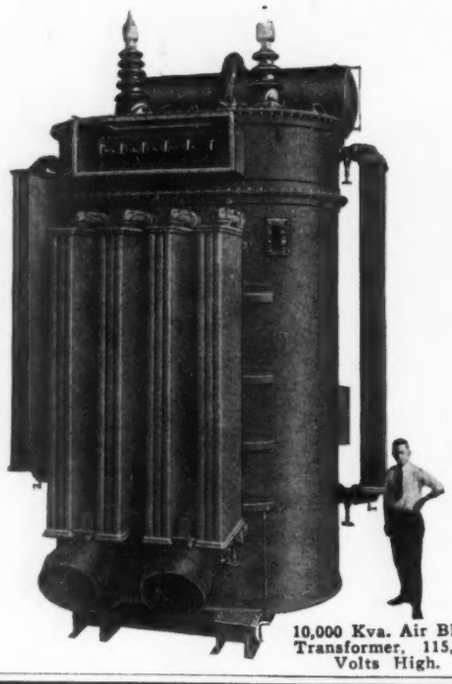
—TRANSFORMERS—



10,000 Kva. Air Blast Transformer, 115,000 Volts High.

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The story of MOLONEY reliability is told and retold in the years of satisfactory service on whatever type of installation MOLONEY TRANSFORMERS are used.

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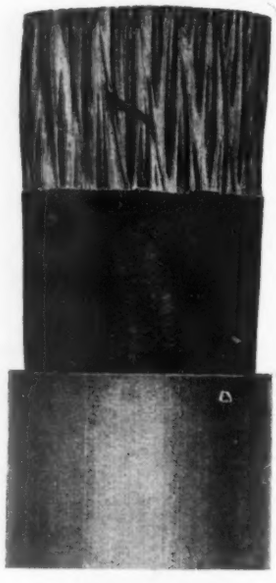

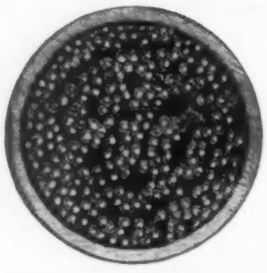

For Supervisory or Miniature Control
LATOX LEAD COVERED CABLE

Many of the smaller substations of electric light and power companies and electric railways are operated by so-called "supervisory control" from the load dispatchers office—which may be located a mile or more from the substation. Switches, transformers, cable circuits, and metering devices are "cut in" and "cut out" through sensitive relay apparatus which usually operates at 125 volts A.C. or 250 volts D.C. with very small current values —¼ ampere or less.

LATOX Lead Covered Cable is a new, dependable type of cable for supervisory or miniature control service. The copper conductors are insulated with a thin layer of LATOX, a new type of rubber insulation made directly from rubber latex.

The insulated conductors combine the advantages of rubber and paper insulation. LATOX rubber insulation is put on the conductors evenly and thinly to obtain the light weight and small diameter of paper insulated cables and has the dielectric strength of rubber insulation which insures against voltage breakdown. LATOX insulation does not absorb water. It is practically pure vulcanized rubber, has exceptionally long life and retains those qualities which make rubber the best insulation yet devised for wires and cables.

Further information will be furnished upon request.

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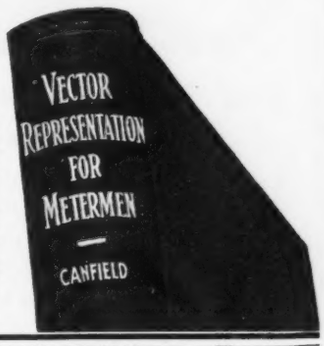
You can use Vectors

in solving problems that occur in meter work!

—for the man with limited mathematical training.

For years we have tried to get a book like this, a simple, non-mathematical explanation of the theory of the Vector and its manipulation in the representation of alternating voltages and currents. Now we have it. It has grown out of Professor Canfield's classes for metermen conducted in conjunction with the National Meter Committee of the N.E.L.A. It is just the book that electric utility metermen and many other electrical workers have long awaited.



Vector Representation for Electrical Metermen

by **D. T. CANFIELD**

Associate Professor of Electrical Engineering, Purdue University

180 pages, 5½x8, 59 illustrations, $2.00

This book is really simple, practical, understandable; it sets aside once for all the notion that a vector is something only a college professor can understand. Many of the problems contained in Part II with their worked out solutions are actual problems that have come up on meter jobs and were suggested by metermen for inclusion in the book.

Some of the topics fully, clearly discussed and explained in this book:—

—classification of polyphase systems;
—generation of three-phase voltages;
—the Y-connection;
—the Delta-connection;
—the two-wattmeter method of measuring power in a three-phase system;
—effect of power factor upon the wattmeter readings;
—wattmeter readings at power factors of 50 per cent and less;
—determination of whether a wattmeter reading is positive or negative;
—importance of phase rotation;
—examples of improper connections in three-phase, three-wire metering;
—two element polyphase wattmeter method;
—principles of reactive volt-ampere metering;
—use of the phasing transformer;
—measuring reactive kilovolt-amperes in a three-phase, four-wire system;
—etc., etc.

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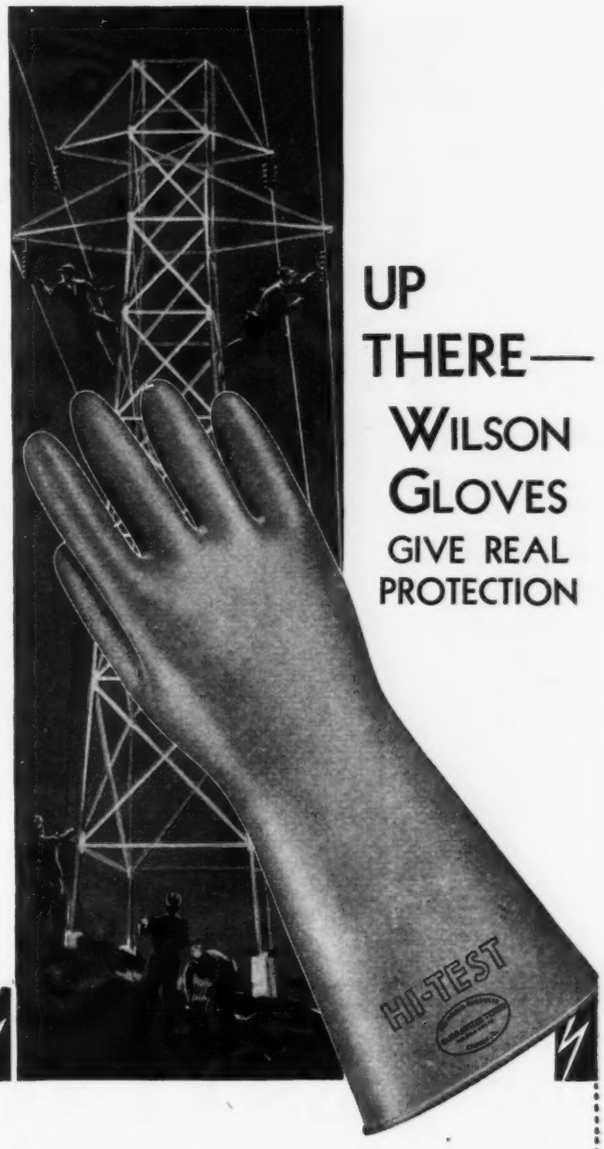

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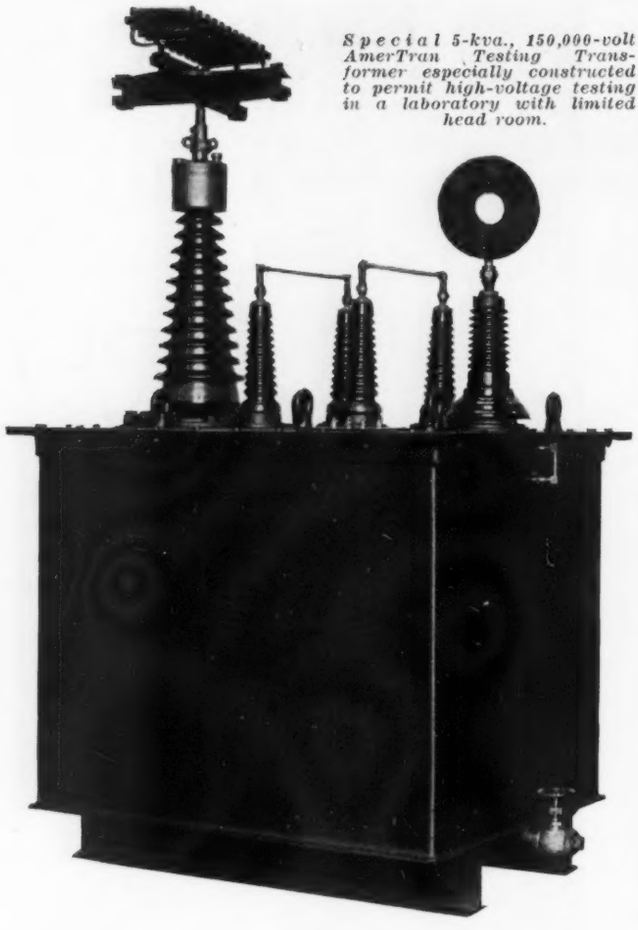

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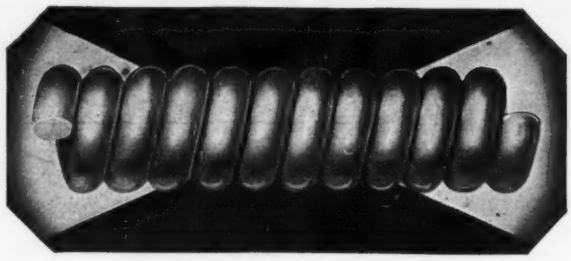

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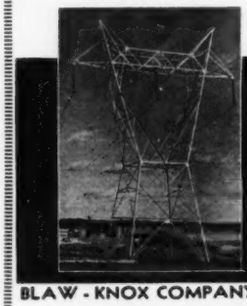

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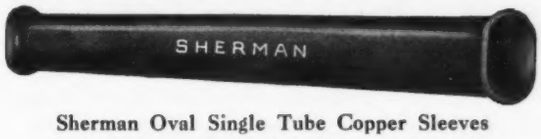
These Sleeves are manufactured to well known Sherman Standards from extra quality electrolytic copper of high conductivity. They are seamless and free from burns. Of correct temper. Packed in neat cartons for shelf stock. The name "Sherman" on the carton insures dependability.



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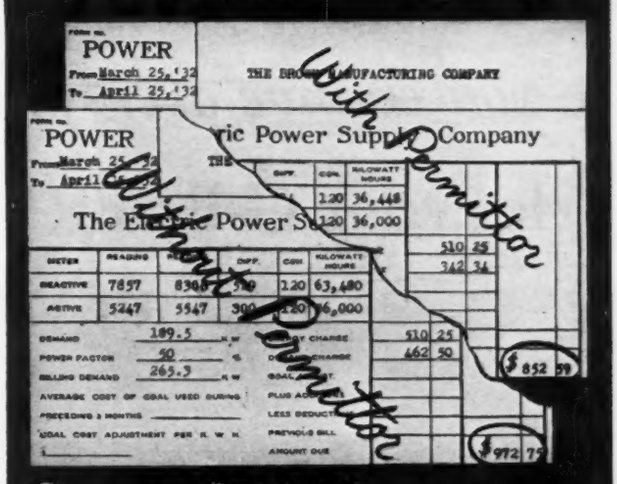

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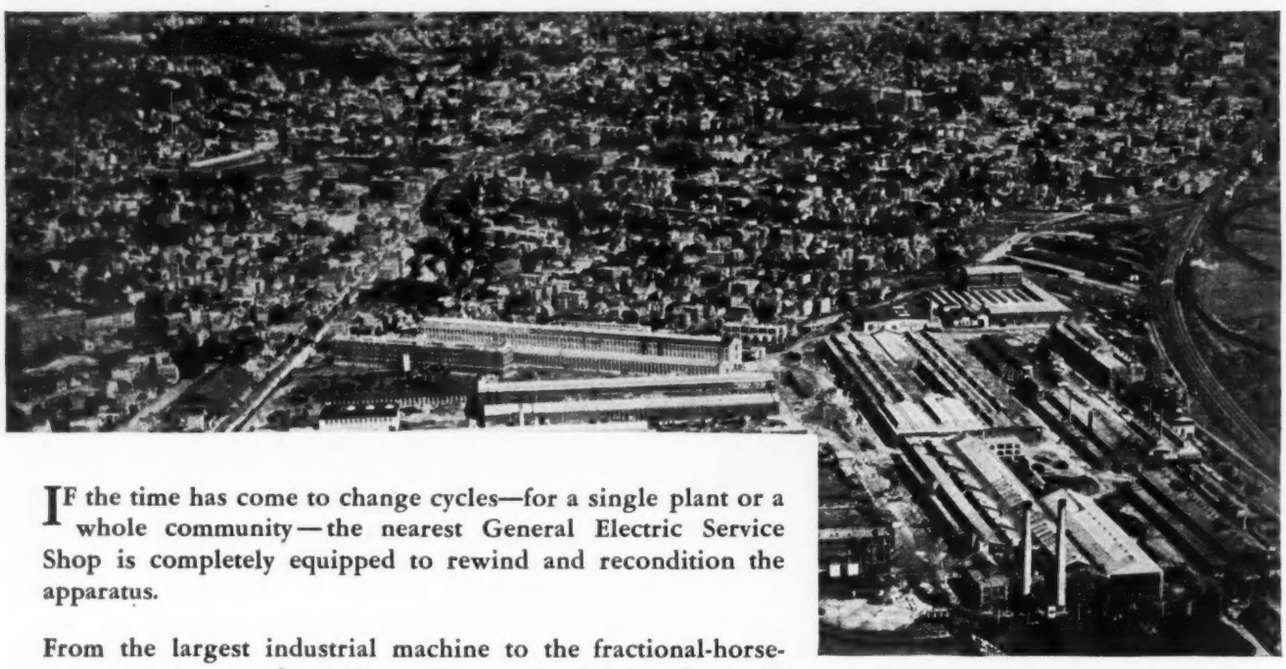

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TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., June 16, 1932.—Sealed bids in duplicate, subject to the conditions contained herein will be publicly opened in this office at 2 p.m., July 14, 1932, for furnishing the materials and performing the work required for installing one freight elevator in the U. S. post office, etc., at Glendale, Calif. The successful bidder will be required to furnish a performance bond of 50 per cent of the contract price. The prevailing rate of wage shall be paid all laborers and mechanics employed on the project as provided in the Act of March 3, 1931 (Public No. 798). Drawings and specifications may be obtained from this office. JAS. A. WETMORE, Acting Supervising Architect. (261)

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2	100	900	230–2300	3	G.E.
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No.	Hp.	R.p.m.	Volts	Type
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1	500	900	440–2200	G. E. Syn.
1	350	900	2200/4000	Wh. syn.
2	300	600	445–2300	G. E. syn.
1	250	600	2200/4000	C. E. syn.
1	250	600	220–440	Westg. syn.
1	250	600	440–2200	G. E. syn.
3	200	514	4150–2300	G. E. syn.
2	175	3-ph.	60-cy.	2300-volts, G. E.
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1—25/100	300/1200	Westgh.	SK
1—75	200/600	Westgh.	SK-210
1—75/100	500/1000	Croc.-Wheeler	CMC
1—80/100	475/950	Electro. Dyn.	30-S
1—60/80	525/1050	Electro. Dyn.	25-S
1—50/60	225/600	Westgh.	SK-190
2—40	300/900	Westgh.	SK-17
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1—25/33	275/825	Electro Dyn.	25-S
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150	2200–440–220	G.E.	514
150	220–440	G.E.	720
150	220–440–550	G.E.	600
125	220–440	G.E.	1800
100	550	Westghse.	900
100	2200	Westghse.	900
100	2200	G.E.	720
100	440–220	G.E.	720
100	440–220	G.E.	900

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300	440	G.E.	225
240	2200–440–220	G.E.	600
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144	2200	G.E.	900
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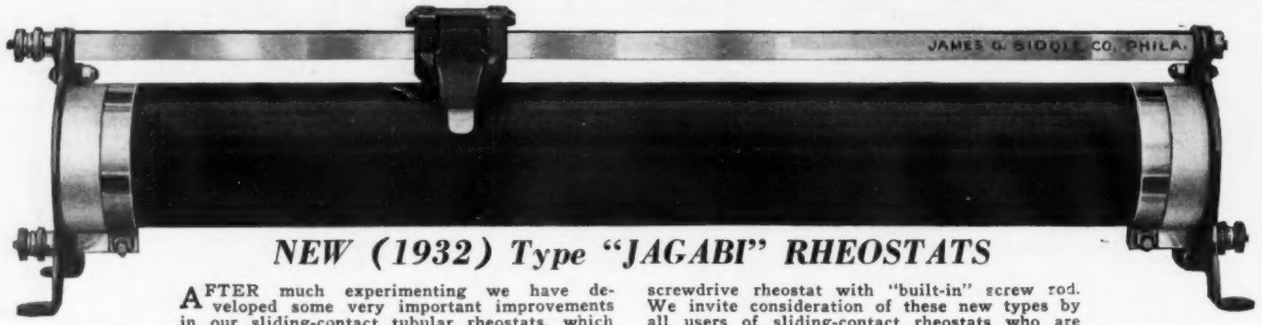

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ALPHABETICAC INDEX TO ADVERTISERS

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Electrical World* assumes no responsibility for errors or omissions

	Page
American Bridge Co.	26
American Insulating Mchy. Co.	16
American Steel & Wire Co.	8
American Transformer Co.	20
Anaconda Wire & Cable Co.,	Front Cover
Baehr, William A.	23
Bakelite Corp.	17
Barker & Wheeler	23
Biddle Co., James G.	26
Black & Veatch	23
Blaw-Knox Co.	20
Byllesby Engrg. & Manag. Corp.	23
Cheney, Edward J.	23
Cooper, Hugh L.	23
Daley & Co., M. J.	23
Detroit Electric Furnace Co.	26
Directory of Engineers	23
Duncan Electric Mfg. Co.	Back Cover
Electric Bond & Share Co.	24
Electrical Testing Laboratories	14, 23
Electrical World	3
Engineers, Directory of	23
Fibre Conduit Co.	16
Fowle, Frank F.	23
G. C. A. Mfg. Co.	24
G. & W. Electric Specialty Co.	5
General Electric Co.	7, 15, 22
Hemingray Glass Co.	6
Hivoltage Equipment Co.	20
Hoosier Engrg. Co.	23
Hoxie, Geo. L.	23
Imperial Porcelain Works, Inc.	16
Indiana Steel & Wire Co.	20
I-T-E Circuit Breaker Co.	Third Cover
Jeffery-Dewitt Insulator Co.	20
Johns-Manville Corp.	16
Kearney Corp., Jas. R.	9
Lacombe, Charles F.	23
Lee Engineering Corp., W. S.	23
Leffler, Wm. S.	23
Lincoln Meter Co.	13
Lucas & Luick	23
McGraw-Hill Book Co.	19
Main, Inc., Chas. T.	23
Mead, Daniel W.	23
Moloney Electric Co.	18
Products Protection Corp.	21
Rockbestos Products Corp.	16
Roebling's Sons Co., John A.	12
Sanderson & Porter	23
Sargent & Lundy	23
Scheidenhelm, F. W.	23
Searchlight	24, 25
Sherman Mfg. Co., H. B.	21
Simplex Wire & Cable Co.	18
Squire, W. J.	23
Stevens & Wood	23
Steward Mfg. Co., D. M.	16
Turner, Howard M.	23
Waggoner Construction Co.	23
Wagner Electric Corp.	4
Westinghouse Elec. & Mfg. Co.	10, 11
Weston Elec'l Instrument Corp.,	Second Cover
White Engrg. Corp., J. G.	23
Wilson Rubber Co.	19
Wolverine Tube Co.	26
Wray & Co., J. G.	23

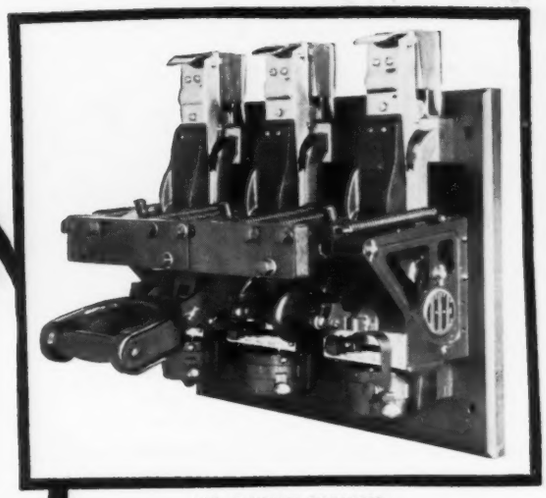
■

PROFESSIONAL SERVICES 23

■

SEARCHLIGHT SECTION
Classified Advertising

Classification	Page
AGENTS WANTED	24
EDUCATIONAL COURSES	24
Bliss Electrical School	24
EMPLOYMENT AGENCIES	24
EMPLOYMENT SERVICE	24
POSITIONS VACANT	24
POSITIONS WANTED	24
PROPOSALS	24
WANTED TO PURCHASE	25
USED AND SURPLUS EQUIP.	25
Belyea Co., Inc.	25
Electric Service Co., Inc., The	25
Grainger, Inc., W. W.	25
Hall Co., Inc., Stephen	25
Hemphill & Co., Inc., J. L.	25
Sachsenmaier Co., Geo.	25



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